# Practical Guide to Photographic & Photo-mechanical Printing Processes

by

W. K. Burton

Marion & Co
London

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# PREFACE

I HAVE to acknowledge the assistance of many who have aided me in getting the information necessary for the preparation of this book. I have freely made use of all kinds of publications on photographic matters in my efforts to acquire a practical acquaintance with processes. Wherever I can tell whence my knowledge has come I do so, but it is possible that in some cases I have not done so. With most of the processes described I have been familiar for some time. With others, whenever possible, I have recently made myself practically familiar, and when one has become familiar with a process he is liable to forget whence his knowledge came. If, therefore, I have sinned in not acknowledging sources of information when I should have acknowledged them, I have sinned unwittingly.

I must make special mention of one friend who has helped me more than others. The most difficult part of my task has been to get a knowledge of photo-mechanical processes. Here I have been most materially aided by T. Bolas. His lectures on the subject before the Society of Arts I have, of course, made free use of—they constituting the standard work on photo-mechanical printing in England; but further than that, I have found Bolas ever ready personally to help me to overcome difficulties, to discover causes of defects, etc. In fact, his wide knowledge of the subject has been always at my command, requiring merely to be drawn on.

Engineering College,
Imperial University, Tokio, Japan,
31*st May* 1887.

# INTRODUCTION

THE term "Photographic Printing" might, with propriety, be applied to any and every process for obtaining a positive photograph from a negative,—that is to say, for obtaining a picture with the gradations of light and shade somewhat as they are seen in nature, from one in which their values are reversed, the light shades being represented as dark portions of the image, the dark as light.

It is usual, however, to confine the term to such processes as are applicable to a flexible support, generally paper, but sometimes cloth or other fabrics.

It is the writer's intention to use the term chiefly in this partially restricted sense, taking into consideration all processes which are actually practised for producing positives on paper, cloth, etc., but not leaving entirely out of consideration those for producing positives (commonly called transparencies) on glass, on china, and so forth.

The object of this work is to give practical instructions in the working of all processes which are in actual everyday use at this date, and the author's attempt will be to make such instructions of so full a nature, that they may serve as a guide to any one who may wish actually to practise the processes. To make the work complete, processes which have at one time been popular, but which have been superseded by others, will be described; but more briefly than those which are now actually used, the interest attaching to defunct processes being really little more than historical.

In the cases of the most popular processes the chemical reactions will be briefly discussed, but the writer will avoid technical language as much as possible. He will also avoid all treatment of the purely artistic side of photographic printing, aiming to give such instructions only as may lead to that technical excellence which is *one* of the necessities of artistic work.

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# CHAPTER I

## HISTORICAL SKETCH OF PHOTOGRAPHIC PRINTING PROCESSES

### *Processes before that of Daguerre*

ALL the photographic processes, before that which bears the name of Daguerreotype, appear to have been negative processes. The lighter shades of nature being shown as blacks, the darker shades as whites.

To Nicéphore de Niepce is due, so far as is known, the credit of producing the first photograph in the sense of a camera picture. Niepce had been for several years at work experimenting with various substances, but it was not before 1827 that he produced anything which could be called at all successful. Even then it was negatives only that he produced [1]—a fact greatly in favour of his process, had the thought struck him to use his results as a means to an end, but not as pictures themselves. The idea does not appear to have struck him, however, or, if it did, he was unable to work it out, for we find him, in his correspond-

[1] It is only fair to say here that Niepce described a method whereby he proposed to turn his negatives into positives—not to reproduce positives from them. This was by the use of fumes of iodine to darken the parts of his silver plate not covered with bitumen. I can scarcely imagine that the method was efficient for the purpose indicated ; but it seems quite possible that the use of iodine, as described by Niepce, laid the foundation of the iodide of silver process for which Daguerre commonly gets all the credit.

ence, describing attempts he is making to get positives directly in the camera. This was first done, or at any rate the means of doing it was first published, in 1839 by Daguerre, who took all the credit to himself of the invention of the process, known as Daguerreotype, although it is becoming more apparent, the more the subject is investigated, that the credit was really due, at any rate in great measure, to Niepce, who had entered into a partnership with Daguerre, but who died before the results of their joint investigations were published.

### *The Daguerreotype*

The Daguerreotype was a positive process. The image produced in the camera was a positive, and, therefore, there was no need to print from it, even had it been possible to do so.

### *Talbot's Process*

But almost at the very same time that Daguerre published the Daguerreotype process,—one month before, in fact,—Fox Talbot in this country announced the invention of a negative process on paper. This was in 1839, but I can find no mention of any attempt to print or produce positives from the negatives till 1842, when Fox Talbot, in patenting his well-known calotype process,—a second and improved negative process,—mentions its applicability to the obtaining of positive copies from negatives. It is probable, however, that Talbot had used his original paper process, which was certainly far better suited to the purpose, for the production of prints. In this first process chloride of silver was formed on paper, and chloride of silver on such a support forms an excellent film for positive prints, in fact, it constitutes a process for printing used at times even to this day, and is probably a better process than some that have almost entirely replaced it. Fox Talbot's second process, in which iodide of silver is used, is not nearly so applicable to the production of pleasing prints.

It is pretty certain that the earliest prints that are still preserved, actually produced by Fox Talbot, are on paper which had been treated with chloride of silver. Some of these still remain in a very perfect state of preservation.

### *Toning of Prints*

At a very early date in the history of silver printing it was observed that the colour of the prints, as they came from the hyposulphite bath used for fixing—that is to say, for the removal of the chloride of silver not acted on by light—varied, some being of a much more pleasing colour than others. It was found that the bath, after it had been kept for some time, gave deeper, darker coloured prints than when fresh. It was soon surmised that the darker colours with the older solution was due to the silver salts dissolved from the paper, and silver chloride was afterwards added to the hyposulphite bath for the express purpose of giving the dark colour, of toning, in fact, this being the first toning process that we have any record of.

Gold, in the form of chloride, was subsequently used, first in an acid solution, afterwards mixed with the fixing-bath, then in the "*sel d'or*" bath which contained only a small quantity of hyposulphite, and was used before the fixing bath, and finally in an alkaline solution before or after fixing.

### *Albumen used in Printing*

The introduction of albumen was brought about, at a very early date, from the desire to keep the sensitive salts of silver as much as possible on the surface of the paper. The idea of the very high gloss now common did not suggest itself. In fact, in the older prints on albumenised paper there is to be seen no gloss at all, they are only distinguishable from prints on plain paper by the somewhat finer detail that is to be seen. The gloss was a thing that came by degrees as the manufacturers improved their means of production. The gloss is considered by many, however, to be the reverse of an improvement.

I have indicated the steps whereby the printing process, which, in spite of all opposition, is the favourite process at this present day, has arisen. The results obtained by its aid leave but little to be desired in the way of beauty of colour and delicacy of detail, but, alas! there is a terrible drawback to the process—the results are not permanent. It was not long after the very first prints were produced by Talbot that he observed that time had the effect of causing them to fade. Since the time mentioned much has been done to improve the permanency of prints by the favourite albumen process; and there are to be found good authorities who do not hesitate to say that, with our present knowledge, a print on albumenised paper may be as permanent as the paper itself, if due precautions be taken.

Whether this be so or not, the fact remains that since doubt was first thrown on the permanency of silver prints, experimentalists directed their attention to the working out of a process which should be undoubtedly permanent, in which the image should be formed of some substance which was known not to be subject to change.

### *The Carbon Process*

The first process which really successfully fulfilled these conditions was the carbon process of Swan, in which the image was produced of carbon in a very fine state of division, held in suspension by gelatine. There were, however, various steps leading up to the process of Swan.

As early as 1839, Mungo Ponton published the fact that in certain conditions bichromate of potash is sensitive to light; or, to speak more correctly, may form compounds or mixtures which are sensible to light. Thus he found that on soaking a sheet of paper with a solution of the salt, drying it in the dark, and afterwards placing it in bright light under an engraving, he got a faint yellow picture on an orange ground, which could be finer by simply washing it in water. This discovery formed the germ of the present carbon process, which is perhaps now the best known of all processes for producing permanent prints. It was subsequently discovered that various organic substances, such as gelatine, gum, starch, etc., were rendered sensitive by bichromate of potash, in the sense that when treated with it in solution, dried, and afterwards exposed to light, they were rendered insoluble in water. This was a great step, for it now became evident to Poitevin and others that there lay in this fact the potentiality of a practicable printing process, inasmuch as, by exposing under a negative, paper treated with, for example, gelatine, to which had been applied a solution of bichromate of potash, some parts (those which had been acted on by light) would be rendered insoluble, whilst others (those protected by the high lights, or dense parts of the negative), would remain soluble, and further, inasmuch as the soluble portion of the gelatine might afterwards be washed away with hot water.

Various attempts failed, on account of the impossibility of getting "half-tone." Where the gelatine was rendered quite insoluble, as in the deepest shadows, it was all right, and the same was the case where it was left quite soluble, as in the highest lights. But in the half-tones the film consists of a surface of insoluble gelatine, with soluble gelatine behind, the soluble protected by the insoluble from the action of the hot water, used for development, and either failing to be dissolved by the water, or if dissolved, carrying away with it the insoluble outer surface, which should have remained to form the half-tone.

J. C. Burnett, in 1868, got over the difficulty by the ingenious device of printing through the paper supporting the film of gelatine. By this arrangement all the gelatine rendered insoluble was next to the paper, whilst that left soluble was on the outer surface, and could readily be washed away.

There are, however, obvious objections to printing through the paper, one being the additional length of time involved, another being the liability that there is for any grain in the paper to show in the print. Burnett's process was therefore superseded by Swan's.

But whilst these various experimenters were working towards the process of Swan, which, to all intents and purposes, is the carbon process of the present day, a permanent process which, if restricted in its uses, was yet perfect, so far as it went, had been invented. Messrs. Garnier and Salmon, in 1858, described a process in which paper treated with citrate of iron, and exposed under a transparent positive, was brushed over with a dark powder, when a print was produced, the citrate of iron being naturally "tacky," and causing the adhesion of the powder, but being rendered hard and dry where acted upon by light, and in such parts not "tacking" any powder. The process, modified to a great extent, is slightly used at the present day under the name of the "Powder Process."

J. W. Swan, in 1864, brought before the public what may be looked upon as really the first carbon process of any real value for practical printing. He produced what he called a "carbon tissue." Gelatine was dissolved in water, in which also was dissolved bichromate of potash; finally, carbon in a very fine state of division was introduced so as to form a "pigment." Paper was then coated with the mixture, and was dried. It was afterwards exposed under negatives, an actinometer being used to time the exposure, as no visible image was produced. The print was now coated with a solution of rubber in benzine, and was cemented by passing it between rolls to a second rubber film. Warm water was applied till the gelatine next the paper (still soluble) was softened, when the paper could be stripped away, leaving only the gelatine, soluble and insoluble, with the pigment, etc. The insoluble gelatine was then washed away by the further application of warm water, till nothing but the image or picture was left. This image was now brought into contact with the paper intended to act as a final support, albumen being used to cause it to adhere; and when the whole was dry, the application of benzine softened the rubber, and enabled the print to be stripped from the plate used for development.

The only improvement of any importance which has been made on the process of Swan arose from the discovery, by J. R. Johnson in 1869, that it is quite unnecessary to cement the undeveloped print out of the support used in development, for the reason that, if the tissue be placed in water, and be brought into contact with any waterproof support whilst the gelatine is still swelling, it (the tissue) will adhere firmly by atmospheric pressure.

It had been observed previously by Vogel that cement was not at all times necessary; but he had not noticed that the only condition necessary to secure adhesion without cement was that the support be impermeable to water. Johnson used ridged supports, such as sheets of zinc and opal glasses, but Sawyer some time ago patented a "flexible support," consisting of paper rendered impermeable to water by treatment with varnishes.

The bichromate of potash is not always mixed with the gelatine before the paper is coated. A tissue prepared by coating paper with a mixture of gelatine, water, and colouring matter may be dried and put on one side. In this condition it will keep for a very long time, and it can be sensitised at any time by floating it on a solution of bichromate of potash in water.

### *Uranium Salts in Printing*

A historical sketch of printing processes would be incomplete without some mention of the use of salts of uranium. These found very great favour with the photographic public some twenty years ago, one of the claims of the process being that it gave results very much more permanent than those on albumenised paper with silver. To how great an extent time has proved this theory to be correct I am unable to say. The process has now dropped entirely out of use; so far as I know, no single photographer at this date producing prints by its means.

It was known in its most popular form under the title "Wothly-type," Wothly being the name of the inventor of a particular variety of the uranium process. He deserves, so far as I am aware, the credit of being the first to use collodion on paper for positive printing. Since his time collodion, holding in suspension chloride of silver, has been used as a film for positive printing with very good results.

### *The Platinotype Process*

Perhaps the process which most deserves notice after the carbon process of Swan is the platinotype process of Willis, patented in 1874, and now in general use.

In this process paper is coated with a ferric salt, and also with a salt of platinum. When the paper is exposed under a negative, the ferric salt is turned into a ferrous salt wherever it is acted upon by light. Now a ferr*ous* salt has the power when it is in solution to reduce a platinous salt to metallic platinum, and ferrous salts are soluble in oxalate of potash. It is therefore possible by floating a print of the kind described—the image in ferrous salt, on a solution of oxalate of potash—to develop an image in platinum-black,—that is to say, in metallic platinum, in a very fine state of division. The oxalate of potash dissolves the ferrous salt, which latter immediately reduces the platinous salt.

Platinotype prints are extremely delicate and beautiful in colour. They resemble in general appearance the very finest engravings, and it is claimed for them that they are absolutely permanent.

### *The "Blue Process"*

An application of the action of the light on ferrous salts just explained has been made use of in a process much older than the platinotype. It is the well-known "blue process" used for the copying of plans, etc. It will be completely understood when I explain that ferri-cyanide of potassium takes the place of the salt of platinum in the platinotype process, and that ferri-cyanide of potassium forms a blue compound with a ferrous salt—in fact, forms Prussian blue. The compound is, however, formed without the necessity of dissolving the ferrous salt, and therefore the blue prints can be fixed in water only.

These blue prints have for the most part been used in copying plans, the prints showing white lines on a deep blue ground; but quite recently the process has come somewhat into fashion for printing from a certain class of landscape negatives.

### *Processes requiring but short Exposures, and suitable to direct Enlarging*

For the production of enlargements it has always been considered advisable to have a process more rapid than any of those just described, because, unless very expensive appliances with large lenses, etc., be fixed up, the time taken to enlarge with any ordinary printing out process is enormously long. Even with the solar, enlarging arrangement just referred to, the photographer is dependent on bright sunshine. It is of course unnecessary to say anything as to the uncertainty of his having it in this country.

When more than one enlargement is required, it is common to make an enlarged negative from which large prints are taken in the ordinary way, and this process is, as a rule, gone through even when only one print is wanted in any of the printing out processes; but it has always been the desire of photographers, at least to be able to enlarge directly for some of their work without the intervention of a negative.

Iodide of silver on paper (the calotype process without the oiling of the paper) was much used, a comparatively brief exposure giving an image which could afterwards be developed. Afterwards "collodion transfers," as they were called, were very popular. These were simply transparencies on wet collodion films transferred from glass to paper.

### *Gelatino-Bromide Printing*

Recently gelatino-bromide paper has been very much used for the purpose just indicated. I believe that Swan, the inventor of the carbon process already described, patented printing on paper coated with a gelatino-bromide emulsion as early as 1878. Certainly the first gelatino-bromide prints I ever saw were in his hands, and were shown in Edinburgh a little after that date.

It was not, however, till several years after the date just mentioned that gelatino-bromide became at all popular. Since its first commercial introduction, however, it has gained very rapidly in popularity, and now it is used very extensively both for direct enlargement and contact printing. Its makers claim permanence for it, and there can at any rate be no doubt that prints produced on it are far more permanent than those on its rival—sensitised albumenised paper.

### *Gelatino-Chloride Processes*

Quite recently two processes in gelatino-chloride of silver have gained great popularity. The one is a process by development, the other a process for printing out. The introduction of the former of these produced quite a sensation in the photographic world in the years 1884-1885, the process being really the first in which prints having the appearance of those on albumenised paper could be produced with a short exposure to artificial light and subsequent development. I do not defend the photographic public in taking a print on albumenised paper as their standard, but such a print has undoubtedly been the standard till quite lately. Lately there has been a decided tendency towards an engraving black or deep gray as a standard.

The second of the two emulsion processes mentioned is a gelatino-clow-citrate emulsion,—that is to say, an emulsion containing both chloride and citrate of silver, and also generally citric acid in excess. It prints out in the same way as sensitised albumenised paper, and is toned on a bath very similar to the old *sel d'or* bath already mentioned.

At the last exhibition of the Photographic Society of Great Britain, there were exhibited prints in silver (presumably chloride) on various papers, such as cartridge and drawing paper. They were produced by S. F. Mostyn Clarke. Some of these were decidedly artistic. I hope to be able to give particulars of the manner of production.

# CHAPTER II

## HISTORICAL SKETCH OF PHOTO-MECHANICAL PRINTING PROCESSES

FROM the very earliest days of camera photography, it was in the minds of photographic experimentalists that it should be possible to print by mechanical means from blocks photographically prepared. That it should be possible to print in the printing-press from blocks which were really nature-blocks untouched (in the sense of drawing, hand-cutting, etc.) by hand.

The problem has been most perseveringly attacked, with the result that many processes of greater or less degree of perfection have been worked out.

The great difficulty to be overcome was the production of "half-tone." To produce two tones merely, a white and a black, as in the copy of a pen and ink drawing, was a comparatively easy matter; but to produce besides these all the intervening gradations, such as we see in nature or in a good photograph, was a most difficult matter.

Blocks produced by photo-mechanical processes may be divided into three groups: (1) Those in which the parts of the block intended to print black are sunk, cut, or etched under the general surface. These are known as entaglio blocks or plates. In these the ink is first applied generally to the surface, it is then rubbed off the elevation, and afterwards the remainder extracted from the depressions by the paper, thus forming an image dark in proportion to the depth of the depressions; (2) processes in which a film is so treated that various parts of its surface differ in their capacity for absorbing a greasy ink, or in repelling it, careful inking resulting in an image on the block, of intensity varying with the capacity of the different portions of the surface to absorb ink. This image in ink is afterwards transferred by contact paper; and (3) type blocks in which the elevations receive the ink which is afterwards taken up by the paper, the half-tone in such a case being produced by some sort of stipple, or lining, or grain, as in various kinds of engravings.

In the case of the first two of the three groups of processes (especially the first of all) very careful inking up is required, and the proofs can only be pulled comparatively slowly. In the case of the third process, the blocks can be printed in the ordinary way with type.

Certain processes of the first two classes have been worked out to a very high pitch of excellence, but I must confess that I have never yet seen a print from a photo-mechanical type block produced at the same time as ordinary printed matter in a common printing machine which was quite satisfactory, but the rapid improvement which may be noticed holds out good hope that this much desired end may before long be attained.

Besides the photo-mechanical processes mentioned above which reproduce half-tone, there are various processes for representing true tones only. These are most useful in reproducing plans and maps, pen and ink drawings, etc., and are, in many cases, superseding wood-engraving, as by their means the artist, drawing on white paper with black ink, may have his drawings reproduced with absolute accuracy, in place of being reproduced as the wood-engraver chooses, or is able to interpret them.

To only one photo-mechanical process that I know of can the term "half-tone" be applied with the strictest accuracy. In this one process only is there the absolute and uninterrupted gradation that we have in a silver or a carbon print. In all others the half-tone impression is produced in a manner similar to that in which it is got in a wood-engraving.

Printer's ink in reality gives only one tone, black or a deep colour. In an engraving there is really only one tone, or two if we include the whiteness or tint of the paper as one, the appearance of half-tone being produced by dots or lines of absolute black, having between them the white of the paper. The relative depth of the various half-tones is not due to variation of the colour of the ink, but to variation of the ratio of area occupied by black lines or dots, and of intervening white paper. Thus for a very dark shade the black lines or dots are broad or large, with but little space between them; for a light shade the lines or dots are thin or small, and far apart.

### *The Woodbury-type Process*

There is, however, as I have said, one photo-mechanical printing process in which there is a true gradation in the strictest sense of the word, in which the various shades are produced by varying thickness of a coloured transparent pigment, the darker shades being represented by greater thickness than the lighter. The process is known as the Woodbury-type, after its inventor, the late Walter B. Woodbury.

Roughly, the process consists in producing an entaglio or sunk-in impression of the object to be reproduced, the deepest portions representing the darkest shadows. This mould is then filled in with transparent coloured ink, which is afterwards removed on a paper support.

The first hint of the method of producing the entaglio image that I can discover is contained in a patent granted to A. L. Poitevin in 1855. A glass or other plate was coated with bichromated gelatine, it was dried, and was exposed under a negative, the result being that those portions which had been acted upon by light were rendered insoluble, whilst those which had been protected by the dense portions of the negative could be washed away, leaving a relief. From this relief there was then produced an entaglio, either by making an ordinary plaster of Paris cast, or by soaking the surface of the relief with reduced silver, and taking an electrotype mould of it.

It will be seen that the same objections apply to this method as to the early method of carbon printing. Only *two* tones could be correctly registered. This difficulty was got over by Woodbury in 1865 by applying the bichromated gelatine to thin plates of talc which could be printed from the back. From the reliefs thus gained, which gave a perfect representation of half-tone, electrotype moulds were produced as by Poitevin.

It would appear that during 1864 both Swan and Woodbury had been working in the same direction, and it appears doubtful to whom should be given the credit so far. The step, however, which rendered the method actually applicable to practice certainly emanated from Woodbury, so that it is with justice that the process as now worked bears his name.

There were certain mechanical difficulties in the way of getting perfect electrotypes from the gelatine relief blocks on account of their swelling in the electrotyping fluid. The discovery was, however, made by Woodbury that, if the gelatine reliefs were dried, they were so hard that they would produce an entaglio image in lead or type-metal by simple pressure, the gelatine actually sinking into the type-metal block. From this entaglio a casting on paper was made by pouring a warm mixture of water, gelatine, and transparent pigment into it, laying a sheet of paper on it, and bringing a platen down on it so as to squeeze out all the superfluous liquid. The platen was left down till the gelatine was set stiff, when it could be lifted, and the proof set on one side to dry.

The process has been simplified in various details, but in all essentials remains as it has been described, unless we consider the quite recent process entitled Stannotype, almost the last outcome of Woodbury's inventive genius to be but a modification of it. In this process an entaglio block is produced directly by exposing a film of bichromated gelatine under a *transparency*, and developing with hot water. This block, when dry, is used to print from directly, tin-foil being used as a protective film to prevent the gelatine entaglio being attacked by the water of the pigment.

I have placed the Woodbury-type process before all other photo-mechanical processes, because, as I say, it is the only process which can be quite strictly termed a half-tone process. All the other processes which give a half-tone are printed in opaque ink, and the half-tone is got, as described above, in the case of engravings, some means being used to break up the surface of the block into lines, dots, stipple, or grain of some kind.

### *Ordinary Engraving Processes*

Before considering the various photographic methods of printing by photography from entaglio plates wherein a simulation of half-tone is produced by such lines, dots, stipple, or grain, it may be well to say a word or two on ordinary engraving from metal plates, lest my readers be unacquainted with the general principles of the processes.

Copper-plate line engraving may be taken as a typical case. A polished plate of copper is used, and lines are cut into the surface in either of two ways. The graver or dry point is used, and the lines are actually cut away or impressed by hand. This is generally called dry-point engraving. The results are very fine, but the work is difficult and tedious. An easier method is to cover the surface of the plate with a thin film of wax. This is scratched away in lines by needles with points more or less sharp, and the plate is afterwards treated with some etching fluid, which will eat away copper. This fluid does not act where the surface is protected by the wax, but eats away the copper where it is not. The wax is afterwards removed.

The method of printing from such an engraving is as follows:—The whole surface of the plate is covered with printer's ink by dabbing it on. Afterwards all except that which has sunk into the lines is removed by wiping the surface of the print first with a cloth, then with the hand. These operations require very great skill, the difference between the proof produced from a copper-plate engraving by one who has no practice in the art of printing and one who is an adept at it being wonderful.

The plate properly inked, paper is brought into contact with it, the paper is backed up with flannel or other somewhat elastic padding, and the whole thing—plate, paper, and backing—is subjected to great pressure by drawing it between a metal plate and a roller. The paper is thus forced into contact with the ink in the lines, and an exact copy of them is the result.

A process which is much more nearly allied to various half-tone photographic processes than line processes, is that known as "mezzotint." It depends in principle on the fact, that if the polished surface of the copper be merely roughened it will hold the ink, and will hold it in proportion to its roughness, a stipple being produced, in which the ratio of black to white is greater, the rougher the surface is.

The first operation is to roughen the *whole* surface of the plate by means that it is not necessary here to mention. The engraver then works by *smoothing* those parts of the plate which are to represent the lights. He uses tools called scrapers and burnishers, smoothing to just such an extent as he knows by experience is necessary to produce the tint he requires.

In aquatint a stipple is produced by covering the surface of the plate with a spirit varnish, which, in drying, cracks up into minute fragments. The plate thus being bitten with acid a half-tone, much resembling that of a crayon drawing, is produced. This is worth mentioning, as in a manner very similar to this was a stipple first produced in photo-engravings.

### *Very early Photo-Engraving Processes*

The earliest record that I can find of any process of the nature of photo-engraving is by Poitevin, who, in 1842, attempted to turn the Daguerreotype image into an engraved plate. He gives accounts of methods of producing both engraved (entaglio) and raised blocks, but it is not clear whether he expected to get a rendering of half-tones by his processes, and it is quite evident that if he did he would be disappointed. His method was to electro-plate the exposed, developed, but unfixed Daguerreotype plate, when there was a deposit only on the lights (the parts represented by an amalgam of mercury), the unaltered iodide of the shadows refusing to take up copper from the solution. This produced an entaglio engraving. The method of producing a raised block depends on similar principles, but is somewhat complicated, and it is scarcely worth the space it would take to describe it in detail here.

In 1843 Claudet patented in this country a process for etching the Daguerreotype plate with acid. His specification is not so clear as to make it quite comprehensible how he proposed to proceed, nor does it appear that he made any special provision for obtaining half-tone.

### *Fox Talbot's Photo-Engraving Processes*

The first engraving process of any real practical value appears to have been that of Fox Talbot, patented in 1852. In this process he makes use of the properties of bichromated gelatine. A steel plate is coated with a layer of this substance; it is exposed under a transparent positive, and is then developed with a solution containing vinegar and sulphuric acid. This washes away those parts of the gelatine which have not been acted upon by light, and, in fact, leaves a half-tone positive in gelatine differing from a carbon print only inasmuch as there is no pigment in the gelatine. The plate is then etched with a solution of "bichloride of platina," which eats into the steel, and roughens it most when the gelatine has been washed away. Fox Talbot also patented at this time the first method of obtaining a grain for representing half-tone. He proposed to obtain it by impressing on the gelatine film, previous to its exposure under the negative, "the image of a piece of folded gauze or other suitable material. In 1858 Talbot improved his process by introducing the use of powdered resin for the production of a grain. A plate was coated with bichromated gelatine, and exposed as before. It was then covered with a little powdered resin, and heat was applied till this melted. The image in this case, when the film had been exposed and developed by simply soaking it in cold water, consisted of a positive image, varying in its different parts in permeability to water or any aqueous solution, those parts where the light acted most strongly being rendered quite impermeable. But besides this, the whole of the film was, so to speak, broken up into a grain, the spots of resin resisting the penetration of water, whilst the interspaces permitted it to pass. The plate was now at once etched by dipping it in a solution of perchloride of iron, which ate away the metal wherever it reached it.

The precise method of action is in this case worth following, as it is typical of the manner in which an appearance of half-tone is sometimes obtained in photographic engraving processes by means of a grain.

Where the light has acted most powerfully, the gelatine is rendered quite incapable of transmitting the etching fluid, and the metal then under these portions is not acted upon at all. Where the light has acted a little less, the film is slightly permeable, but, of course, only where there is no resin. The interspaces between the resin are in such parts of the film represented by thin faint lines. But where no light has acted, the gelatine has remained quite soft; it swells up, and readily transmits the etching fluid. It is true that it only permits it to pass where there is no resin on the surface, but the film being swelled up, the etching fluid passes more or less under the spots of resin. The action, in fact, spreads sideways, so that the interspaces are represented by broad lines, or indeed the action may go on so long that the resin-protected spots are completely undercut, and that in the parts representing the deepest shadows the surface is etched throughout. We thus have a gradation quite complete from a surface not eaten into at all to one eaten away altogether, the intermediate gradations being represented by a net-like pattern, with the lines of varying thickness. Very excellent results were obtained by the process of Talbot's just described. Indeed, I have seen some that compare quite favourably with modern processes.

The Woodbury process has been already described. It has been made subservient to the production of entaglio engravings, to be printed from in printer's ink, as shall be described hereafter.

### *Modern Photo-Engraving Processes*

Coming down to the consideration of modern processes, it may be at once stated that by various methods of photo-engraving results are being continually produced so perfect that it is difficult to imagine any improvement on them. At the same time, it must be admitted that full particulars of some of the best processes—those, it would be more correct to say, by whose aid the best results are produced—have not been published, and that, moreover, there is never any certainty as to how much hard work has been put on the engravings. Indeed, it may be confidently stated that, except very rarely, a plate is never printed from till it has had much hard work put on it. Thus by skilfully covering up some portions, and re-biting or re-etching, the plate may be much improved. Again, the graver is used to give more depth in places, and the lights are improved by smoothing the copper with a smoothing tool. Photo-engraving is used, more than for anything else, for the reproduction, on a large scale, of pictures. The time required for the preparation of such a plate is, according to H. Trueman Wood,[1] reduced from years to months in the case of one of the most popular processes. In fact, the impression gained directly by photography on the plate can only be looked on as a basis for the work of the skilled engraver.

[1] To save the trouble of continual reference, I here acknowledge my indebtedness to the gentleman just mentioned, whose book, *Modern Methods of Illustrating Books*, I have found most useful in enabling me to give short descriptions of processes with which I am not myself familiar.

### *The Woodbury Photo-Engraving Process*

The firm Goupil et Cie have long been famous for the remarkably fine photo-engravings that they produce. The precise process used has been kept secret, but it is supposed to be a modification of one by Woodbury. In this process a Woodbury relief is prepared exactly as in the Woodbury process already described, but that the bichromated gelatine has incorporated with it powdered glass. The relief is stamped into lead or type-metal, as in the case of the ordinary process, the difference, of course, being that the powdered glass produces a grain. From the lead block a copper-plate is got by double electro-plating.

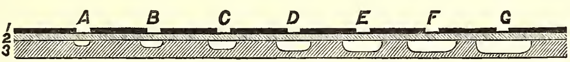
### *Klie's Process*

Messrs. Annan of Glasgow produce very fine engravings by the process of Klie, which differs from that of Talbot, last described, only inasmuch as asphalt dust is used in place of powdered resin, and that this is spread on the copper-plate—that is, between the copper and the bichromated gelatine film—in place of on the film.

### *Waterhouse's Process*

In 1880 Major Waterhouse described a process, giving what he termed a "discriminating grain,"—that is to say, a grain in which the black spots or dots are of larger size (the interspaces consequently narrower) in the shadows than in the high lights. The process, I believe, was found to be somewhat defective in practice, but the principle of a "discriminating grain" is one, the importance of which cannot be exaggerated. In fact, it is only in virtue of a "discriminating grain," or something analogous to it, that any appearance of half-tone can be given by a process in which black ink is used. To make this clear, it must be borne in mind that the ink itself gives no half-tone; that every point of an engraving surface must either print quite black or quite white. Now the mere introduction of a grain throughout a whole picture, with spots and interspaces of equal size throughout, will not help in any way to render the representation of half-tone in a photograph possible. Two tones only can be produced in this way—that represented by printing the grain on to white paper, and that represented by white paper alone, untouched, that is, by printer's ink. What is required is a grain in which any proportion of area occupied by black, and area occupied by white, may be produced. The truth would appear to be that in the case of all the processes, except that of Waterhouse just mentioned, a discriminating grain has been produced rather by accident than by the design of the inventor.

It was pointed out in the case of Talbot's improved process how a discriminating grain was produced by the lateral action of the etching fluid. Besides this, there is




to be taken into account the result of what has been termed the "creeping action of light." This is in reality a lateral action of light. When light acts on a film of any appreciable thickness, the action tends to spread sideways to a less or greater amount, according to the intensity of the light, or the time that it is allowed to act. This may perhaps be explained by imagining an entirely hypothetical case. We shall suppose that in the sketch given here, 3 represents a copper-plate, 2 represents a sensitive film of such nature that wherever it is acted upon by light it will eat into (or allow some etching fluid to eat into) the copper-plate, whilst 1 is a graining screen made up of some thin opaque film, penetrated by minute holes of the same size, and at equal distances from each other. These holes are lettered A, B, C, D, E, F, and G. Now let us suppose that the whole is exposed to light of varying intensity, strongest at G, and gradually decreasing in strength towards A, as might be the case did the film represent a small portion of a sensitive substance exposed under a portion of the half-tone of a negative. The ultimate result on the copper will be to pit it in somewhat the manner shown, the pits being not only deeper where the light has acted most strongly, but being broader also.

Again, there may be a slight spreading action of ink itself. Thus if two lines be engraved or etched on a copper-plate, both of the same width, but one considerably deeper than the other, the deeper line may print out broader than the other.

Somewhat in the manner that I have described has a more or less perfect "discriminating grain" been automatically produced in all, or nearly all, photo-engraving processes, although, in the case of some of them, it must be confessed that it is very difficult to see how the result is brought about. So far as I know, Major Waterhouse was the first to suggest a method directly intended for the production of a discriminating grain. As I have said, his process has not, so far as I have heard, been perfected in practice yet; but it is probably not too much to say that on the production of a thorough discriminating grain will probably depend the invention of any photo-engraving process that will be capable of producing good results without a deal of hard work.

In Waterhouse's process a Woodbury relief, or a carbon image, is developed on a copper-plate. On to this is sifted fine sand, which has been waxed by placing some wax amongst a quantity of it, heating the mass, and keeping it stirred till it is quite cold. The grains of sand striking the surface of the film enter to some distance where the gelatine is soft, producing pits. They do not, of course, enter the bare parts of the copper at all, and, throughout the half-tones they enter just in proportion to the softness of the gelatine. The film is dried, the sand is removed, and an image with a "discriminating grain" remains. This is reproduced in copper by double electro-plating, being first of all black-leaded, to make it a conductor of electricity. Sawyer, of the Aulotype Company, recently improved the process by introducing powdered plumbago into the gelatine, of which the film was produced, thus avoiding the necessity of black-leading it. E. W. Foxlee has since that time produced some photo-engravings of very great perfection. I hope to be able to give particulars of his process further on.

*Obernetter's Photo-Engraving Process*

The only process that I know of which differs in anything but matters of detail from those already described is that of Obernetter, which is both original and wonderfully ingenious. A positive is produced on a film of gelatine-bromide of silver very rich in the silver salt. The silver of the developed and fixed image is converted into chloride of silver by the action of a mixture of perchloride of iron and chromic acid. The film is then wetted and brought into contact with the surface of a copper-plate, which it etches, the chlorine leaving the chloride of silver to combine with the copper-forming chloride of copper, which is soluble in water.

*Photo-Lithographic Processes, etc.*

The processes that next come under consideration are surface-printing processes. Before entering into details of the action of these, it is desirable to explain very briefly the essentials of the ordinary lithographic process invented by Semfelder at about the end of last century. Put as briefly as possible, the process of lithography depends on the fact that, if the surface of slabs of certain porous stones be made greasy in parts, if the stone be then wetted and inked with a greasy ink, this ink will adhere only to the greasy parts of the stone, not to any other. It is then only necessary to produce on the stone a design in grease, or in any greasy fluid, either by drawing it directly on the stone or by transferring it from paper, when the stone may be printed from by damping it, inking it up, and bringing paper into contact with the surface.

When we come to treat of the reproduction of line subjects, it will be seen that the lithographic process, pure and simple, can be used for reproduction of a line subject through the intervention of photography. Meantime we have to consider processes similar to lithography in that they depend on the power of the surface to attract or repel a greasy ink, and applicable to the production of half-tone.

### *Surface-Printing Processes*

The earliest record that I can find of any attempt at a photographic surface-printing process, by a greasy ink, is of 1854. In this year Guiseppe Devincenzi patented a process wherein he proposed to transfer a photographic image in a greasy ink on to a lithographic stone, and to print therefrom. As in many other cases of the earlier specifications of photographic inventions, the wording is so vague as to make it appear very doubtful whether the patentee himself understood his invention, and to make it very certain that he is incapable of making any one else understand it by a written description. Next year, however, Poitevin described the process which has since come to be known as Lichtdrück in Germany, "Collotype" in England, with such clearness that, whatever improvements and modifications have since been made in practice, to him must be given the credit of the invention.

### *The Lichtdrück or Collotype Process*

The collotype method depends on the fact that gelatine, in its natural state, when wetted and allowed to swell up, repels a greasy ink, whilst gelatine rendered insoluble by the action of bichromate of potassium and light refuses to absorb water, but takes a greasy ink freely.

The following is, described as briefly as possible, the method of working the process. A sheet of glass or other hard substance is coated with a thin film of bichromated gelatine. This is dried very quickly, and is exposed under a negative. A faint image is seen after exposure. The plate is next washed in cold water, when those parts which have not been acted upon by light swell up. It will readily be seen, if the explanations above have been followed, how *two* tones can be obtained—one a black, where the gelatine has been rendered quite inabsorbent of water; the other a white, where the gelatine has swelled, and refuses to take any ink at all. During development there is, however, a curious action in the half-tones. The portions represented by half-tone do not merely become non-absorbent to a certain greater or less degree, but the surface *reticulates* or breaks up into a fine netlike series of markings. The precise nature of this marking, reticulation, or grain can scarcely be explained in words; but it has the property of taking the ink in some parts whilst it refuses it in others, and thus produces a very fair rendering of half-tone. The size of the grain or reticulation varies. It is much easier to print from a coarse-grained plate than from a fine one, but the results are very inferior. In the best collotypic work the grain is not visible to the unaided eye at all.

The printing from a collotype plate is performed precisely as in the case of a lithograph. The plate is, that is to say, damped, inked up, and printed from. The inking up requires very considerable skill. The number of impressions that can be pulled direct from a collotype plate is limited. In 1861, however, Colonel Sir Henry James proposed to transfer an image from the collotype plate to stone or zinc for the purpose of enabling copies to be multiplied, to all intents and purposes, indefinitely. The purpose for which he intended this transfer process to be used was, it is true, only for the copying of maps and line subjects; but recently the process has been elaborated, and lithographic transfers of collotypes in half-tone are produced.

### *Type Block Processes*

We now come to the last of the three methods of printing, namely, that by raised blocks. The method in ordinary printing from types and wood-engravings is, as every one will understand, of this nature. In the case of wood-engraving a flat wooden block is used, and all that is not intended to print is cut away, the portion remaining in relief being inked and brought into contact with the paper.

In the relief process, as in the entaglio, there is no true half-tone. The half-tone must, as in the cases already described, be represented by lines, dots, grain, or stipple of some kind.

It may be remembered that Poitevin, in his very early experiments, pointed out methods of producing directly from the Daguerreotype both entaglio and relievo blocks, but there is no indication of any method of rendering the half-tones. Indeed, it is only of quite recent years that this has been accomplished with even an approach to success.

When an entaglio reproduction in stipple or other half-tone from a photograph became possible, a block reproduction became possible also, inasmuch as it was possible to transfer the impression to a zinc plate, and to etch this latter. The same also may be said of collotype.

It is necessary, before seeing more of block processes, to explain this method of etching a zinc block. An image in fatty ink is transferred to the surface of the zinc block. This image is "inked up" as if it were to be printed from, but really to increase the thickness of the ink film so that it may be sufficient to withstand the effect of dilute acid. The back and edges of the block of zinc are varnished so that they also may be protected from the action of the etching fluid, into which the whole block is now placed. The acid slowly etches or eats away those parts of the surface which is not protected by the fatty ink, leaving the latter in relief. Before sufficient depth of etching can be obtained, and to prevent the acid from undercutting the lines, various manipulations are gone through, the lines being several times treated with a further protecting film, and the etching being repeated.

The difficulty with all blocks produced in the manner indicated when the stipple or grain is very fine—as is quite necessary for surface blocks—is to get sufficient relief, without which there is a tendency for the interspaces to become filled up with printer's ink, and that consequently, except in the case of the most skilful printing, the results are very poor. Even when the printing is most skilfully performed, and when, therefore, there is no tendency to smudginess, there is sometimes a tendency to flatness and a lack of range of half-tone.

Besides the methods already explained of getting grain or stipple in entaglio tile engravings, or on surfaces such as collotype or lithographic plates, there are two which, although they might doubtless be used in entaglio or surface processes, are, I believe, as a matter of fact, now at least, used only in the production of surface blocks. I give them in the words of Mr. Trueman Wood.

"Copying mechanical network, stipple, or grain on one of the sensitive surfaces used in the production of the printing surface, or introducing granular material into the substance of one of these surfaces."[1]

This latter method is very similar to that of Woodbury and that of Waterhouse, already mentioned, as applicable to photo-engraving.

### *The Pretch Process*

As early as 1854 Pretch patented a process for making an electro-plate impression from a plate which had been coated with bichromatised gelatine, exposed under a line negative, and developed by washing the portions away, which had not been affected by light, with hot water. He subsequently made his method applicable to the production of a raised block for printing with type, by developing the exposed plate (the film on which had in this case been very rapidly dried) in *cold* water precisely as in the case of collotype. In fact he produced a collotype, but in place of printing from this directly, or transferring the image to stone, he made an electrotype cast of it, and used this as a raised block. The results obtained by this process are somewhat coarse, but are well suited to some subjects.

It will be remembered that in the very first engraving (entaglio) process of Talbot, it was proposed to obtain a

[1] "Imparting stipple to a Woodbury film or analogous relief."

grain or stipple by the use of "the image of a piece of folded gauze or other suitable material."

This principle, so far as I know, has seldom or never been used for the production of entaglio engravings, but recently it has been greatly used for the production of raised blocks. When I say that the principle has been used, I mean that some body, such as gauze, having a pattern of opacity and transparency, has been used at some part of the process to give a grain to the surface. Thus gauze has been introduced between the negative and the sensitive surface used as a means of producing a surface block. Either actual gauze or a photographic reproduction of it on a film negative, or a reproduction of black crossed lines, or merely of black parallel lines, has been used. The same has been introduced in front of the negative in the camera, or the negative or a positive from it have been brought into contact with a piece of gauze or a stipple screen of some kind, and the two together have been copied in the camera. In fact the changes have been many in every conceivable way, always with the same ultimate object, to produce on a block which could be etched an image in some protective machine with the half-tones broken up into a uniform stipple.

Of all these processes the same thing may be said. It is very difficult to see how they succeed at all. At first sight it would appear that they ought to fail, because, considering that a block can only, at one point, print quite black or quite white, it is difficult to see how any half-tone is to be got from a pattern consisting of dots of equal sizes at equal distances, or of lines of equal breadth at equal distances. There is nothing in all this of the nature of a "discriminating grain." Still the processes are more or less successful.

### *Meisenbach's Process*

A process of the nature just described was amongst several worked with greater or less success by Messrs. Bullock and Swan for some fifteen years, when it was patented by Meisenbach of Munich in 1882. The following is a precise description of his process :—

"A transparent plate is hatched or stippled in parallel lines. A transparent positive is made of the object (which it is desired to depict). The two plates are joined, preferably face to face. From the combined plates a definite negative is photographed in the ordinary manner. In order to cross-hatch and break the lines of the shading, the hatched or stippled plate may be shifted once or more during the production of the said definite negative. This negative is transferred in the usual manner to form a typographic block."

It will be seen that no special means are here used for the production of a discriminating grain, yet it is undeniable that such exists in the pictures produced by Meisenbach. If one of these be examined by the aid of a powerful magnifier, it will be found that the image in reality consists of equidistant dots. In the highest lights these are of course quite absent; but in all other parts they are present. In the lightest shades, however, they are represented by the minutest points, whereas in the shadow they are so large as to run into each other.

If Meisenbach really produces the excellent results that he obtains by the method that he patented, one can only conclude that the discriminating grain results from the "creeping action" of light already treated of.

### *Woodbury Block Process*

Of the various methods of producing type blocks by the aid of a Woodbury relief, it may be said, that in them there is a very thorough provision for obtaining a discriminating grain.

Woodbury himself worked at the production of type blocks from a gelatine relief, between which and the transparency under which it was printed there was introduced a screen of gauze or network, and producing, from the resulting grained impression, a block by pressure as already described in treating of the Woodbury process. I believe, however, that the process has never been worked on any large scale.

### *Ives's Process*

Ives followed in the track of Woodbury, and some fifteen years ago patented a process which appears to possess all the essentials for successful working.

The principle which he introduced was the use of an impression in relief to crush down the grain of a paper with an even and marked grain. Where the relief was highest it flattened out the grain entirely, where it was lowest it did not even touch it. Between these two extremes there was a gradation of various amounts of flattening out. The relief being inked, the flattened portions of the grain only were blackened, and thus a print having half-tone represented in dots or spots of varying sizes was produced. This could either be copied in the camera, the negative being used for the preparation of a transfer, or the image could be directly transferred to a zinc block, which could then be etched.

If a transfer were to be prepared, it was done in the following manner:—Transfer paper, consisting of paper coated with a film of bichromated gelatine, was exposed under the negative. Those parts which received the action of light (representing the dots) were rendered incapable of absorbing water, whilst the other parts (representing the parts of the paper not inked) retained the capacity. The parts which swelled with water repelled greasy ink—as already described in connection with collotype—whilst the hardened portions attracted it. The transfer paper could thus be inked up, an impression precisely corresponding to that got from the Woodbury relief resulting from this inking, and this impression could be transferred to a zinc block, which could then be etched. Ives has considerably modified his process since it first came out, but the principle remains the same, and he has produced remarkably good results.[1]

[1] For details of these, see Canto's Lectures on the Recent Improvements, in *Photo-Mechanical Printing Methods*, by Thomas Bolas, F.C.S., printed by William Frounce, 10 Gough Square, Fleet Street, E.C.

### *Zuccato's Process*

A process patented some years ago by Zuccato bears a good deal of resemblance to that of Ives. Zuccato, however, in place of a grained paper, uses a block of lead or type-metal, the surface of which has been prepared by planing out very narrow grooves so as to have a series of minute pyramids. The plate is inked and the Woodbury relief is brought down on it, a piece of very thin paper being between the two. The pyramids are flattened out to a greater or less degree, producing larger or smaller spots or dots, which have a very clearly defined outline.

Many other processes could be described, but they are all more or less on the lines of those already given.

### *The Reproduction of Line Subjects*

The reproduction by the aid of photography of subjects in line I scarcely consider ought to come under the heading of photographic printing at all. It is really simply a mechanical printing process to the aid of which photography is called. Still the various processes are much worked, and some brief description of them may not be out of place, especially as the process, which is, perhaps, more used than any other, originated with the father of photography, Nicéphore Niepce.

It is scarcely necessary to point out that any process which is capable of giving a print representing half-tone by stipple is also capable of reproducing a subject in line. Indeed the whole difficulty consists in contriving to get the representation of the half-tone, the representation of only two colours, a black and a white, being simple enough.

In 1827 Niepce submitted to the Royal Society some pictures, taken on plates of metal covered with a film of bitumen of Judæa. The action of light on these films was to render them insoluble in various oils, in which they were otherwise soluble, so that, by giving a sufficiently long exposure in the camera, and afterwards developing with these oils, a sort of image was produced.

Niepce de Saint Victor, nephew of the last-mentioned, used the process for the copying of engravings. He exposed a copper-plate coated with bitumen under an engraving or transparency he wished to copy, by which means all the bitumen, except that under the lines, was rendered insoluble. That representing the lines was then dissolved away, and the plate was etched by placing it in acid. Almost the very same process as this is that which is most commonly used at the present day for the reproduction of line subjects, except that raised entaglio blocks are generally produced.

A negative is prepared of the line subject to be reproduced. It is necessary that this negative be as dense as possible, the lines being at the same time represented by bare glass.

A plate of zinc is coated with a thin film of bitumen, and is exposed under the negative whereby the parts representing the lines only are rendered insoluble. The remainder is now dissolved away, when the block may at once be etched by any fluid that will eat into the zinc, the lines remaining as raised portions which can be printed from.

A very favourite process for the reproduction of line subjects is that in which bichromated albumen is used.

A plate of zinc is coated with albumen which has a certain amount of bichromate of potash dissolved in it. This film, when dry, is sensitive to light just as a bichromated gelatine film is, but it is far more sensitive, and requires only cold water to develop it, as albumen is, unlike gelatine, soluble in cold water. The process gives very sharp, clean lines. After the film has been exposed—just as the bitumen film is exposed, but for a mere fraction of the time—and developed, the plate is etched. The etching may be done directly with an alcoholic solution of perchloride of iron, as alcohol has the effect of rendering albumen quite insoluble and impermeable, or, the image may be inked up—the albumen taking the ink readily—and the plate may then be etched with acid.

Both these methods are adapted to the finest work where great precision is required. Where a less degree of fineness and precision are required, it is usual to have recourse to the transfer method already mentioned in connection with the production of raised blocks for type-printing. The transfer consists, as already explained, of a surface which repels greasy ink except in such parts as form the image. The image may be transferred to a lithographic stone, from which prints may be taken directly, or it may be transferred to a zinc plate, which can then be etched so as to form a relief block for printing.

The method of Pretch has already been mentioned. In it a film of bichromated gelatine, on a rigid support, is exposed under a positive from a line subject. If the subject be an engraving or drawing on fairly transparent paper, and if it be required to reproduce it of the same size, it itself may be used as the positive. If not, a negative must be produced, and from that a positive by contact. The film is either developed by placing it in cold water, in which case the lines swell up, standing above the level of the rest of the surface, or in warm water, in which case the lines are dissolved away. An electrotype copy is thus made which, in the former case, will give an entaglio block, in the latter a relief block.

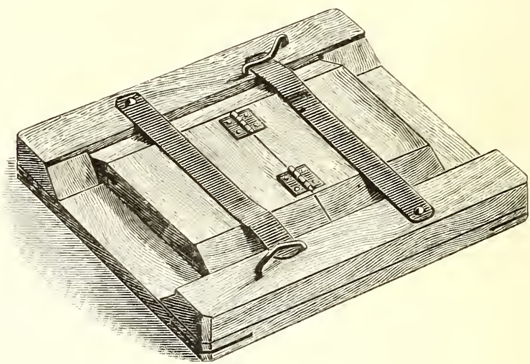
Of all the methods described, wherein a relief block is got through the intervention of a *negative* of the line subject, it need scarcely be said that, if a positive be used, an entaglio plate will result.

Many processes besides those described have been invented with the object of reproducing line subjects, but it is difficult to see any advantage that they possess over those already described, whilst they certainly appear to possess the disadvantage of being more complex in working, or more expensive.

# CHAPTER III

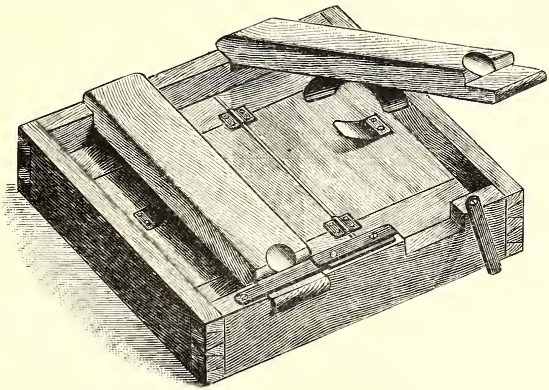
## GENERAL REMARKS ON CONTACT PRINTING

The first and principal requisite for contact printing is a "printing-frame." Printing-frames are of various designs



but in every case the object is the same—namely, to keep the sensitive film which is to be printed in close contact with the negative, and at the same time to provide means of examining, at any time, every part of the film, so as to see how the printing is proceeding. Provision for examination is made by arranging that one part of the film shall be kept in close contact with the negative, whilst the other is separated from it.

The simplest form of printing-frame is here illustrated. It is, in the writer's opinion, not only the simplest (and cheapest), but also the best for all small sizes, certainly up to whole plate ($8\frac{1}{2} \times 6\frac{1}{2}$). It will be seen that it consists of a frame to hold the negative, and a back to keep the film in close contact with it. The back is made in two halves, hinged together. It is pressed by two springs against the film; but either of these springs can be released, allowing one-half of the frame to be hinged back, so that the corresponding half of the print may be examined as it progresses. In the frame just described there is nothing in front of the negative to protect it from being damaged by the strain of the springs; nor is anything necessary for small sizes. For large sizes it is, however, advisable to use the frame



illustrated here, in which there is a plate-glass front, against which the negative lies.

The back is somewhat different in form from that of the cheaper frames; but the object to be effected is the same in both cases.

It will readily be understood that, with a plate-glass frame, it is possible to print a negative of any size—from the largest that the frame will hold to one very considerably smaller. This is, of course, a convenience in many cases.

With a frame having the back in two divisions only, there is a narrow portion of the print, opposite to the hinge, which can be seen only imperfectly, or not at all. This is an inconvenience in some cases, when the very part of the picture that we want to print for, and which is the most important of the whole, comes in the centre. The difficulty is overcome by having the back in three pieces, hinged in two places, and with three springs. It is then possible to open any two of the three parts of the back at the same time.

The backs of the frames are always covered with cloth of some kind. This is sufficient to secure contact in the case of very small sizes, say up to half-plate ($6\frac{1}{2} \times 4\frac{3}{4}$), but for plates above this size pads of some sort are necessary. Pads are made specially for the purpose out of thick felt; but the writer has found a thick pad made up of a number of sheets of blotting-paper to be quite as efficacious, although certainly not quite so convenient.

Further requisites for almost every kind of printing are: flat dishes of the size of the largest pieces of paper to be manipulated. These are generally made of very common white earthenware, covered with a surface glaze, and dignified with the name of porcelain—which they certainly in no way resemble. The glaze very soon cracks, and the earthenware absorbs a quantity of water quite incredible, and also, of course, any salts which may be dissolved in the water. I can state, as a fact verified by my own observation, that when the glaze of an earthenware dish becomes thoroughly cracked and absorbs as much of a saturated solution of a soluble salt as it can, it will keep giving up this salt again to clean water for weeks even if the water be changed every day or two.

A consideration of the facts just mentioned will make clear the advisability, if earthenware dishes be used, of confining one dish to one particular purpose, and to one only. I am glad to know, however, that recently there have been introduced dishes of real vitrified stoneware (granitine). These are non-absorbent, and if carefully washed after they are used for one purpose may afterwards be used for another.

For most kinds of printing some arrangement for thoroughly washing the prints is required. This is specially the case with prints in silver on albumenised paper. With these the washing requires to be very thorough, and many special appliances have been designed. Sundry of these will be illustrated when I come to treat in detail of the process commonly known as silver printing.

With the appliances mentioned, the photographer will be in a position to *commence* the practice of silver printing, and most other departments of contact printing; but as he goes on various other appliances (all of a simple nature) will be required. For other processes further appliances will be needed. These will be described as the necessity for treating on the use of them arises.

# CHAPTER IV

## SILVER PRINTING

### *Printing with Ready Sensitised Paper—Trimming the Prints*

THE article commonly entitled "ready sensitised" or "preserved" paper is now a regular institution in photographic printing. It consists of paper albumenised and sensitised before it is sold. It has the advantage that it enables the printer to commence operations without first going through the processes of albumenising and sensitising—either or both. It is very largely used by amateur, and even by professional photographers, and, whether the beginner intends eventually to sensitise his own paper or not (he is not likely in any case to albumenise it), it is certainly advisable that he commence work with ready sensitised paper.

The paper is commonly sold in sheets measuring about 17 × 22 inches. Twenty-four of these make a quire. The paper is sent out wrapped up so that light cannot reach it. It may, however, be freely manipulated in gas or lamp light, or in dull daylight, such as there commonly is in the parts of an ordinary room remote from a window.

The paper is cut roughly to the sizes required—that is to say, leaving a little margin—before it can be put into the frame. It is a common custom to send out sensitised paper ready cut to certain standard sizes—carte and cabinet—and the convenience of this is certainly great. It is, however, of course impossible, if the paper be cut, before printing, to the exact size, to do any trimming after printing; and it often happens, unless the greatest care be taken in adjusting the paper in the frame, that the picture will be a shade too much to one side or the other, or too high or too low; but in the matter of whether the printer purchases his paper ready cut or not, he must use his own judgment.

A piece of paper is placed in contact with the negative in the printing-frame, and the frame is placed in the light.

A word must be said as to the light that it is best to make use of for silver printing. It may probably be said that, for the great majority of negatives, the brightest light short of direct sunlight is the best to work in. Such a light as there is in shade during the brightest summer weather is excellent. It is sometimes difficult to get a place to print in where the direct rays of the sun do not reach at some time of the day. In this case the difficulty may be got over by stretching tissue paper (white of course) over the printing-frames. It is very convenient to have a number of light wooden frames made the size of the printing-frames; tissue paper is stretched across the former, and they can be placed over the printing-frames at a moment's notice. Some prefer for silver printing the effect of sunshine filtered through tissue paper to shadow light.

During the months of November, December, and January the brightest direct sunshine that there is is none too bright for ordinary printing, and indeed in London there are only about six or seven months when it is ever too bright, and even during these months the light is never too intense for more than a few hours of the day. It may be said that if, during printing in the sun, a negative gets perceptibly hot to the hand, it is probably printing too quickly. The converse, however, that if it is not perceptibly heated, it is not printing too quickly, will scarcely hold, as the sun's heat rays are sometimes stopped in passing through the atmosphere in a much greater proportion than the chemical rays.

If the negative be one with very bold contrasts, showing shadows too deep where the lights are printed out, or showing chalkiness in the lights where the shadows are already printed out—one, in fact, giving a hard print—it may be printed in the most brilliant sunlight available. This will produce a print somewhat less harsh than could be got in a less brilliant light. On the other hand, if the negative be slightly on the soft side, giving a print lacking in brilliancy, it is advisable to print it in a light considerably duller than the brightest light short of sunshine. In fact, it should be placed in so dull a light—either by altering its position, or by placing several sheets of tissue paper over it—that it will take about an hour to print.

It requires considerable judgment to be able to tell just how far the printing process should be allowed to proceed before the proof is removed from the frame. The print loses considerably during the various processes that it has to pass through after printing, and allowance must be made for this, the printing being carried so far that the proof, as it comes from the frame, appears considerably too dark. It is difficult to give more than a hint here of the allowance that must be made for alteration of the print during toning and fixing; but I may say roughly that the printing should be allowed to go on for nearly twice as long as is required to produce a pleasing result in the frame. If the negative has been a good one—or it were better, perhaps, to say one suited to silver printing—the appearance of the print as it comes from the frame will be as follows: Looked at as a whole the impression will appear considerably too dark, the brightest lights will be slightly coloured, but only slightly so, and the shadows will appear somewhat "clogged up" on account of the fact that all the deeper shadows have gone to the darkest colour that it is possible to get with the paper by any length of printing. If the shadows be not as deep as the paper will print there is little or no chance that the finished picture will be vigorous or pleasing in colour.

The prints, as they come from the frames, may be placed in any light-tight drawer or box, to remain till there is a sufficient number ready for toning.

I strongly advise that the prints be trimmed before they are toned. A considerable saving of gold is so effected, not to mention the value of the clippings themselves; but, besides this, there is very much less chance that the prints will be torn in going through the various baths if they be trimmed than if they be left with rough edges.

In trimming certain small sizes, especially the standard ones for portraits, there is but little latitude as regards length and breadth, such prints being mounted with but a very narrow margin.

In trimming such prints it is customary to use a "cutting shape," which is simply a piece of thick plate-glass cut and accurately ground to the size of the finished print. The print is held against the under side of this. The fact that the glass is transparent permits of the adjustment of the print to its proper position. When it has been correctly adjusted, the projecting edges of paper are trimmed away by the aid of a pair of scissors, which should have very long blades. Some prefer to use a knife, laying the shape on the top of the print on a board, or, what is much better, on the top of a revolving table, which permits each edge consecutively to be brought into the most convenient position for trimming.

I have said that in the case of some portraits the photographer is pretty well tied down as to size and shape; but it is not so in the case of landscapes, which are mounted with a wide margin, or with large portraits, which are commonly mounted in the same way. In these cases the exact size does not matter, nor does the precise relation of length to breadth. It is, therefore, possible, if it appear desirable, to trim a little off one end or edge of the picture, or off the top or the bottom, and there are remarkably few prints that are not improved by a more or less liberal use of the shears, cutting away, perhaps, an inch of foreground or half an inch at one side, and so forth. The majority of photographers, specially amateurs, appear to be afraid to use the scissors boldly, as if they grudged to reduce the size of their prints; but in this matter they make a great mistake. I say emphatically do not hesitate to cut down the size of your print if an improved, though smaller, picture result from so doing.

The best manner in which to trim prints, when the precise size does not matter, is to mark them out on the face with a pencil—not hesitating to mark a good bit to be cut away if necessary—using a T-square and a drawing-board, and afterwards to cut them with either a pair of scissors or a knife and rule.

It is necessary to say a few words as to certain matters to be observed in the case of trimming. It has been observed by Norman Macbeth, a distinguished painter, that the best ratio of length to breadth in a picture is as the diagonal to the side of a square. Probably the truth of this matter is, that somewhere about two to three represents the most pleasing relation of length to breadth in a picture. Certainly anything squarer than that indicated is but seldom pleasing to the eye.

There are some cases in which it is quite necessary to have the sides, or the top and bottom of a print, parallel to some line in the picture. Thus, if there be a scene with the sea as the horizon line, the top and bottom of the print must be parallel with this line. Again, if any vertical buildings, or vertical objects of any kind, be introduced, it is necessary that the edges of the print be parallel with the vertical line of the side of the building.

It sometimes happens that it has not been possible to keep the back of the camera quite vertical during the exposure of a plate on a very high building, and that there is a convergence of the vertical lines towards the top of the print. If this convergence be but slight, it does not, I think, seriously affect the value of the picture; but care must be taken, when it exists, not to have one side of the building parallel with one side of the print, and the other edge of the building far from parallel with either side of the print. The difference must be split, and the edges of the prints must be made parallel with a vertical line, real or imaginary, down the middle of the picture.

No horizontal line, excepting the sea horizon, should ever be taken as a guiding line in trimming prints.

# CHAPTER V

## SILVER PRINTING—*Continued*

### *Toning Ready Sensitised Paper*

VARIOUS processes of toning of earlier date than the alkaline method of gold toning have been mentioned in the first chapter of this book; but as they have all by this time completely given way to alkaline gold toning, they do not require further mention just now.

Toning is certainly one of the most important operations in connection with silver printing, if it is not the most important. On the manner in which it is performed depends not only the beauty of the finished print, but also, in great measure at least, its permanence.

There are many toning formulæ differing more or less from each other, and in another chapter I give a number of them with a few remarks on each; but here I propose to confine myself to the action of one only, describing carefully the various manipulations connected with its use. The bath I select is that known as "the borax bath." My reason for selecting it is that it is very convenient, and especially for amateurs, or all who tone only at long or irregular intervals, because it may be made up for use at once, whereas many other baths require to be kept for some time before they will work at their best.

Whatever toning formula is used the basis of it is chloride of gold.[1]

[1] A platinum salt is sometimes, but very rarely, used. The writer has used "platinum chloride," sold by a dealer for the purpose of

So-called chloride of gold is sold in small quantities in sealed tubes, each containing 15 grains. I say "so-called" because, so far as I know, the article contained in the tubes is never the pure chloride, or terchloride of gold ($AuCl_3$), but is a double salt of gold and potassium, or, probably in some cases, some other salt, with one or more equivalents of water of crystallisation. This being the case, "15 grains of chloride of gold" gives no guarantee of any absolute quantity of the metal, which, of course, is the active agent in the toning process. Some makers, however, guarantee in each tube a minimum of metallic gold—generally 7 grains—and it is well to purchase only such tubes as bear this guarantee.

The gold having been purchased, it is advisable to make it up into a stock solution at once, so that when a certain quantity of chloride is required, it is only necessary to measure off some of the liquid. The strength of solution commonly made up is 1 grain of chloride to 1 dram of water. A tube is placed in a 2-ounce bottle, when it is broken by the aid of a glass rod, and then 15 drams of water are poured over it. A dram of this solution will then contain almost precisely 1 grain of chloride of gold.

The toning solution, with borax, is as follows :—

| | |
|---|---|
| Chloride of gold . . . . | 1 grain |
| Borax . . . . . . | 60 grains |
| Water . . . . . . | 10 ounces |

About 1 grain of gold chloride will be required to tone the prints from a sheet of paper of the usual size (17 × 22 inches). Indeed, if the gold chloride be up to standard, a little less would probably do, but it is better to waste a little gold at the end of the operation than to have to add gold as the toning proceeds—although it is by no means impossible to make the addition if due care be taken to prevent the local action on the prints of the added gold.

toning, working with the acetate bath given hereafter, merely substituting the platinum salt for the gold. He got excellent black tones, and believes that the platinum salt might be substituted for the gold in any toning formula.

We take then for each sheet of paper to be toned 1 dram of the chloride of gold solution. This is made up to about an ounce with water. A pinch of powdered chalk is put into the liquid and is shaken up with it. The object of the chalk is to neutralise any free acid which may be left with the gold chloride, and which might be hurtful during toning. After shaking or stirring up the chalk is allowed to settle down. Meantime, 60 grains of borax are dissolved in 6 or 7 ounces of hot water. When this latter solution has cooled down, the neutralised solution of gold chloride is added to it, and the quantity is made up to 10 ounces,[1] when the mixture is ready for use.

The prints trimmed as described in the last chapter, and ready for toning, have to be washed in clean water, to get rid of the whole, or the greater portion, of the soluble salts still adhering to them.

This washing may be performed in any vessel wherein it is convenient to manipulate the prints. I think the most convenient vessel of all is a deep sink of white glazed ware sold as "Butters's pantry sink" by various manufacturers of sanitary appliances. The sink has a plug at the bottom, and also an overflow pipe, so that the water may either be changed as often as is considered desirable, or may be allowed to flow into the sink and overflow by the overflow pipe, whilst the prints are turned over by hand.

It is, however, not every printer—in fact of amateurs probably only a few—who are able and willing to fit up a special sink for printing purposes, and I must warn all from attempting to use a sink which is at other times used for negative work. In fact, the further all the operations of "silver printing" of any kind are done from the place where negative work goes on the better.

Failing a special sink an ordinary wooden tub does excellently where a supply of water from a water-tap can be got. Galvanised iron tubes may be used if they are carefully coated inside with black varnish (bitumen in

[1] This quantity is by no means an absolute one, as will be pointed out hereafter.

benzine), or some other protective film; but there is always a little risk of spotting the prints, unless the varnishing be carefully performed; for if those ever come into actual contact with the zinc, or the iron which the varnish is supposed to cover, they will probably be acted upon.

When it is necessary to tone and fix in a room where there is no supply from a tap, and where, consequently, the water must be brought in in a jug or can and carried away in a pail, it is, of course, advisable to economise water as much as possible, and in this case there is probably no more efficient way of washing than the lifting of prints from one flat dish to another. The method of proceeding is as follows:—Two dishes are used. Both are filled half or two-thirds with water. The prints are immersed one by one in the first face downwards, the water is then poured off, fresh is poured into the dish, and the prints are lifted one by one into dish No. 2. The water is now poured from both dishes, and fresh is poured in when the prints are transferred one by one, this time from dish No. 2 to dish No. 1. And so on the process goes till it is considered that the prints are sufficiently washed.

So much for the method of washing. The *extent* of it and various other items come next for consideration.

In giving instructions for manipulating ready sensitised paper, the difficulty presents itself that we have no absolute knowledge of how the paper is prepared. It is, in fact, prepared in many different ways, and probably to get the best possible results it would be necessary to treat each brand in a special manner. We may assume, however, that most of the different brands are preserved by the aid of an organic acid of some kind. At any rate there can be no harm in taking such precautions as will result in the elimination of this acid if it exist, as it would be harmful did it get the length of the toning bath.

One way of eliminating the acid is prolonged washing, the other is neutralisation by the use of an alkali, for example, carbonate of soda.

I consider it best that the printer should be regulated in the matter of which method he uses by the colour which he wishes eventually to have. Every one who has ever looked at silver prints must have noticed that there is a wide range of colour. A range from a light brown, through a darker brown towards a purple, into a black—and if the process be carried to the extreme, into a dull slaty-gray colour.

It is unfortunately the case that with many brands of ready sensitised papers it is not possible to push the toning to any colour much deeper than the brown without a general degradation of the print. With the best brands of paper, however, it is possible to get a good purple colour. In the case of almost all brands it is possible to get a very fine rich, warm, brown colour, which is, to the writer's mind, a very beautiful one. He has already entitled it "Payn Jennings" brown, because it has been seen in great perfection in many pictures exhibited by that eminent artist. "Ready sensitised" paper really affords this brown better than most brands of paper sensitised at home.

I shall take first the two extreme cases: one where a very warm brown (almost a red) is required, the other where a purple is wished.

It will be noticed that whenever the prints are placed in water, the water turns somewhat milky on account of the precipitation from them of salts by the nitrate of silver washed from the paper. After two or three washings the milkiness should be but slight. If it be still very considerable one or two more washings may be given. At the end of this time the prints are laid in a bath containing about half an ounce of common salt to a pint of water, where they lie for five minutes. They are then washed in a few more changes of water, when they are ready for toning.

I have mentioned that albumenised sensitised paper may be manipulated at all stages in either dull, white light or bright gas or lamp light. Dull white light is usually preferred for toning, at any rate to the brown colour, because it is more easy to judge of colour in such a light than in the yellow light of gas.

If the weather is very cold the temperature of the toning bath may be raised a little, but it should never be made more than barely tepid—never should rise above 70° F.

The prints being ready for toning, and the toning solution being in a flat dish, a print is placed into it. The print is turned over once or twice so as to ensure thorough saturation with the toning solution, and eventually is left face downwards in the bath. Another print is similarly treated, and so on till there are several in the solution. As regards the number that may be placed in the toning bath at one time, the operator must be entirely guided by his skill. A beginner should never have more than three or four prints in the solution at once, a thoroughly skilled toner may have as many dozen. In any case the prints must be kept in constant motion by lifting the one that is at the bottom of the dish from under the others, laying it face upwards for a moment on the top of the mass of prints, when it is examined to see if the colour has changed, and is then turned face downwards.

It will have been observed that the prints assumed a very red colour in the salt and water, the red probably approaching very closely what is commonly called "brick-red." In the toning bath they will gradually change from a red to a rich brown colour. When the desired tint has been reached they are removed to a dish of clean water.

If the purple tone be desired, the prints are washed just as described for the brown tone, but carbonate of soda (washing-soda) is substituted for the common salt.

The toning also is performed in just the same way. It proceeds a good deal more rapidly; but to get the purple has, of course, to be carried to a far greater extent. If, with the treatment just described, it be found impossible to get a purple tone, the prints, in place of becoming purple, pass to a colour quite indescribable, but certainly far from agreeable; it may be concluded that the particular brand of paper used is not suitable for toning other than to a brown.

If, however, the colour goes on deepening in a satisfactory manner, the only difficulty is to stop it at the right stage. This is best done, the writer thinks, by examining the colour by artificial transmitted light, by looking through the print at a gas or lamp light behind it. The reason for this is that a little of the colour, as seen by reflected light, is generally lost during the processes which have to be gone through after toning. It is the custom of the writer, when he is toning for a purple colour, to tone till all red or brown, by transmitted light, is gone, except in the very deepest shadow of the print.

If a darker brown than the very light, warm, bright brown that I have described be desired, the prints may simply be washed for a considerable length of time before toning, till all trace, or all but the faintest trace, of milkiness has vanished, and may then be passed at once into the toning solution.

# CHAPTER VI

## SILVER PRINTING—*Continued*

### *Fixing and Washing Prints on Albumenised Paper*

THE prints, as they come from the toning bath, are placed at once in clean water—are washed in several further changes of water when they are ready for fixing. The fixing agent is hyposulphite of soda, or hypo, as it is commonly called by photographers. Whilst writing of this chemical, it is well to mention that it is necessary to be most careful that no trace of it comes into contact with the print before the time of fixing, otherwise the total destruction of the latter is likely to ensue.

Various strengths of hypo bath are advised for fixing. I am of opinion that the strong baths often recommended (4 or 5 ounces to the pint) are liable to cause deterioration of the colour of the prints, especially in the lighter tints. A very good authority on silver printing, Mr. W. Ayres, recommends a bath as weak as 1 ounce to the pint. His own silver prints certainly do not indicate the fault of lack of permanence, but still I should hesitate to advise the use of a bath so very dilute as 5 per cent. As a mean between the very strong and the very weak baths mentioned, I advise one made by dissolving 2 ounces of hypo in each pint of water. Hypo is very cheap, and there can be no excuse for sparing it. It is, moreover, distinctly of advantage to use a large quantity of fixing bath. I recommend that not less than 1 pint for every sheet of paper to be toned be made up.

It is of the utmost consequence that the fixing bath be not acid, and as many commercial samples of hypo have a slightly acid reaction, it is necessary to neutralise the bath, or still better, to make it slightly alkaline. Ammonia is, in the writer's opinion, the best alkali to use for the purpose of neutralising the bath, because, whenever it is in excess, the fact is known by its imparting its very characteristic smell to the solution. Ammonia may be poured drop by drop into the fixing bath till it (the fixing solution) smells faintly of the alkali.

The fixing bath should not be very cold (say never below 50° F.), and as hypo in dissolving renders much heat latent, cooling the solution greatly, it is often advisable slightly to warm the fixing bath before it is used. On the other hand, its temperature should never exceed 70° F.

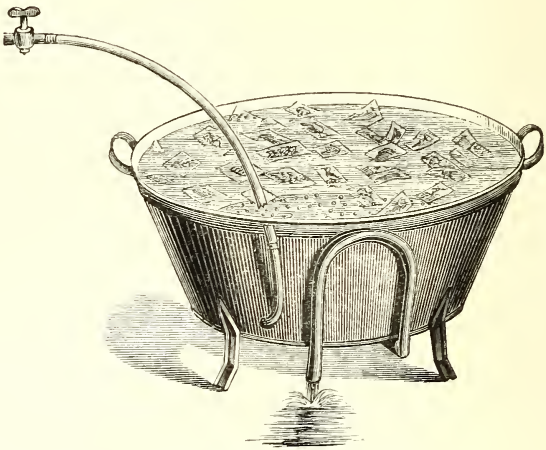
The prints are placed in the bath one by one face downwards, care being taken to press each one well below the face of the solution before another is placed above it. When they are all in the bath the lower print is pulled from underneath the others and is laid face upwards on the top. This operation is gone through till all the prints have been pulled from the bottom of the pile to the top, and the whole thing is gone through again at the end of every five minutes till it has been done about four times, when fixing may be considered to be complete.

If there are a great number of prints, it is better to lift them from one dish to another, both filled with the fixing solution, than to manipulate them entirely in one dish.

The writer is of opinion that the chance of permanency of silver prints would be greatly enhanced if, after the usual time of fixing, they had ten minutes in a perfectly fresh fixing bath.

It is to be distinctly understood that the same fixing bath must never be used twice for prints. If a number of prints have been fixed, the bath is worth saving for the silver it contains. Probably from half an ounce to an ounce of metallic silver may be recovered from each quire of paper fixed—the latter quantity, however, very rarely, if ever, in the case of ready sensitised paper.

The prints once fixed have to be washed so as to eliminate every trace of hypo. The smallest quantity of the salt left in the paper may undoubtedly cause fading of the image. But the writer here wishes to emphasise the fact that there are other causes of fading besides want of washing, and that it is not right, if prints show signs of fading in a few years, to jump at the conclusion that insufficient washing is the cause. Insufficient fixing or acidity of the fixing bath are much more frequent causes.[1] I believe that the second fixing bath recommended above



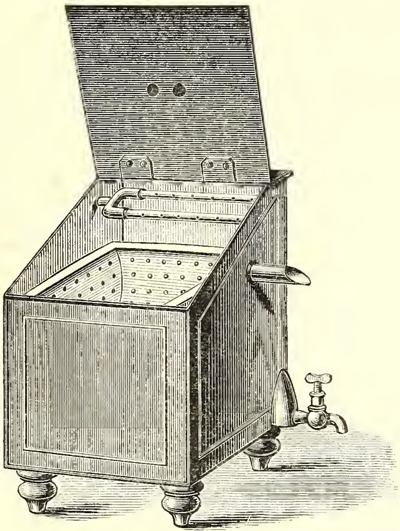
—rendered slightly alkaline—would do more for the permanency of silver prints than all the washing machines in the world.

Still a thorough washing is at least *one* of the conditions of permanence in silver prints, and some means should be taken to secure it. The essential for a thorough washing is, that the washing water should get thoroughly at the prints; should, that is to say, act in quantities on both sides of each print. To secure this the prints must, by some means or another, be kept moving in frequently

[1] Andrew Pringle, *British Journal of Photography*, September 24, 1886.

changed water, or the water in changing must be caused to move between all the prints. One or other of these two objects is attained in most of the machines manufactured for the special purpose of washing prints, the water, in entering the washing vessel, either causing the prints to keep in constant motion, or moving in rapid currents between the prints which do not move. I here illustrate two washing machines.

The old-fashioned method of leaving the whole of a



batch of prints in a tub or other large vessel, whilst water flowed constantly in from a tap and out over the edge, is probably about the least efficient of any, unless the prints be frequently turned over by hand one at a time. If they be not so turned over, they form into a mass at the bottom of the vessel, and there lie, the hypo, which is heavy, having scarcely any tendency at all to leave them. By, however, turning over the prints at frequent intervals (say once in half an hour), and having just previously completely emptied the vessel, and allowed it to fill up again, a very efficient washing is obtained in five or six hours.

Perhaps the best way in which to secure the elimination of all the hypo from prints, if a washing machine be not used, is to wash as described above for three or four hours, then to take each print separately, to lay it on a sheet of clean glass, first face downwards, then face upwards, for a few minutes, whilst a stream of water plays on it. This method will be particularly efficient if the water used for the prints when washed separately is warm.

The method described for washing prints before toning is efficient for washing them after fixing, if the photographer has the patience to carry it on for an hour or two, or can employ any trustworthy person to do so. In this case the last few waters should be warm.

The prints, once washed, may be mounted at once—wet, that is to say—although there are some objections to so doing (see Chapter XXXII.) on mounting prints. If, however, itbe wished to dry them without mounting them, it is almost necessary to take some special means to prevent them from cockling up in a manner which makes them very difficult to handle afterwards.

The best method of treating prints, so that they may lie flat, is to roll them in a rolling press, but many do not possess such an article, and for this reason I shall describe a way in which they may be made to lie flat without the use of such an expensive machine.

The first thing is in any case to get them very nearly dry. A common way of doing this is by the use of drying boards. These are simply sheets of very thick blotting-paper chemically pure. Prints taken from the washing water and allowed to drain are blotted between two of these boards, and are then placed between others, a pile being made of alternate drying boards and prints. If the drying boards be not kept in a very dry place, they should be each dried by warming it before the fire just before use.

On the top of the pile of drying boards and prints is placed a weight, and the whole is left for half an hour or longer, when it will be found that the prints are practically dry. They may now be piled on the top of each other, and be left between two boards under a weight, or better, in a letter-press, for a few days, when, if the surface of the paper has not been high, they will be found to be sufficiently flat and will remain so. If, however, the paper has been one of very high surface, it will tend to curl towards the albumenised side even after the prints have remained for a very long time under pressure. To render such prints flat, the best plan that I know of (next to rolling them in a machine) is to roll them, just after they come from the drying boards, tightly on a small roller, albumenised surface outwards. One print is then rolled tightly round the roller, which may be about 1 inch in diameter, the end of the next print is then caught under the end of the first, and it is tightly rolled up. This process is continued till any number of prints up to about wenty are rolled on the roller, a book-wrapper is then rolled up to make an outside covering, and the roll is put on one side for a few days, or till the prints are required.

There are other methods of drying prints besides placing them between drying boards. Thus they may be blotted off and laid face downwards on drying boards or sheets of pure white blotting-paper. In this case they are rolled up, albumenised surface outwards, as just described, whenever they curl so far that further curling would mean a tendency to unmanageableness. This method is a good one for prints from whole plates or larger.

In the case of very large sizes it is sufficient to lay the wet print across a wooden roller, albumenised side outwards, till it is all but dry, then to roll it up as described above. Some again place the prints face downwards on a string net, then place another net over them so as to prevent them from curling as they dry.

Here let me insert a remark which might as well be inserted in almost any other place. Let the beginner who, on first attempting some apparently very simple manipulation, finds he has some difficulty in succeeding—if, for example, he tears his prints in attempting to roll them up—not conclude that the directions given him are necessarily wrong, but consider that possibly a little practice is required on his part.

# CHAPTER VII

## SILVER PRINTING—*Continued*

### *Albumenising Paper*

MENTION has already been made in the introductory chapters of albumenised paper. The advantage of paper coated with albumen, as it is in these days, is that a glossy surface is produced which gives a depth and transparency to the shadows, and a delicacy to the high lights which cannot be attained without some gloss, and that a great range of very beautiful tones are obtainable. It is quite true that many—and amongst them those who have a right to be considered authorities on the artistic side of the question—object to the glossy surface of albumenised paper very strongly; and, further, that a great deal of the want of permanency of silver prints is probably due to the presence of the albumen. Still the fact remains that at the date of writing the albumen process is still the favourite, and that probably nine out of every ten photographic prints are produced by it. Indeed, so much more is it used than other processes employing silver that, when the term "silver printing" is used, it is always understood to mean printing on albumenised paper.

Briefly speaking, the process is as follows:—Paper is coated with a solution of salt (chloride of ammonium generally, but sometimes common salt, chloride of sodium) in albumen, egg-albumen alone apparently being suitable. The paper is then floated, albumenised side downwards, on a strong solution of silver nitrate, the result being that the albumen is "coagulated" or rendered insoluble in water, a double decomposition takes place between the silver nitrate and the chloride of ammonium in the albumen, silver chloride which is sensitive to light being produced; and further, an action takes place between the albumen itself and the nitrate of silver, an organic compound sensitive to light, to which the term albumenate of silver has been given, being formed.

It is usual in these days for the photographer to purchase his paper already albumenised, even if he do not purchase it ready sensitised as described in a former chapter. Albumenised paper is now so cheap and so reliable that there is no temptation to go through the very troublesome process of albumenising on a small scale. Still no book treating specially on silver printing would be complete without an account of albumenising paper, and for this reason I describe the process here.

First as to the paper. There are at the present day—in Europe at any rate—practically only two brands of paper that are ever used for albumenising—namely, Rive and Saxe. These are both very beautiful plain papers of great purity, evenness, and fineness of texture. They can be had of almost all dealers in this country. They are made in various thicknesses—the thickness being always expressed in terms of the weight of a ream (480 sheets). Papers from 8 to 12 kilo. are commonly used for albumenising, but none under 10 kilo. is to be recommended for any but small work, and I should certainly not advise any photographer who wants to experiment on albumenising to try anything lighter. He will find 10 kilo. Rive or 12 kilo. Saxe excellent for his purpose. The size of the sheets is about 22 × 17 inches, and, of course, on a commercial scale they are coated whole. It will, however, be well at first not to attempt anything larger than a quarter sheet at a time.

The albumen must be obtained by separating the whites of eggs from the yolks. This is done by cracking the shell across and letting the white run out from between the two halves without breaking the yolk. The writer must, however, confess that, in the case of his own experiments in albumenising paper, he has always called in the assistance of one skilled in culinary operations for the breaking of the eggs and the frothing of the albumen to be described hereafter. Every egg will do for about two sheets of paper (with due economy somewhat more), but it must be borne in mind that there must always be a minimum quantity of albumen sufficient to cover the bottom of a dish somewhat larger than the paper to be floated, to a depth of at least quarter of an inch. This means about twenty eggs before a single quarter of a sheet can be floated. In separating the whites from the yolks of the eggs each white should be dropped singly into a cup, so that if the yolk by accident break and get mixed with the white, that egg only need be rejected in place of the whole of the whites already collected, or at any rate the very large quantity of the albumen that it would be found necessary to waste before every trace of the yolk is removed. It must be understood that no speck of the yellow of the yolk must be allowed in the albumen.

The next question is as to the quantity of salt that it is well to use. Thirty years ago it was common to recommend a very large quantity—20, 30, or even 40 grains being mentioned. Very much less salt is now, however, commonly used. I think I may pretty safely say that no commercial albumenised paper is salted with more than 10 grains of chloride of ammonium (or the equivalent in some other chloride) to the ounce, whilst I know that some of those which give exceedingly brilliant prints with deep shadows, and which give better results with a strong silver bath than a weak have less than half that quantity.[1]

From what I can gather, 8 grains to the ounce is a common quantity of chloride of ammonium to use.

For each ounce, then, of albumen that we have, we take 8 grains of chloride of ammonium, which is dissolved in the smallest possible quantity of water, and is then added to the albumen. The quantity of chloride of

[1] See chapters on "The Silver Bath" and on "The Chemistry of Silver Printing," in the latter of which is given a method of determining the amount of soluble chloride, which there is on a given area of paper.

ammonium necessary for 20 ounces of albumen may be dissolved in 1 ounce of water.

The albumen being "salted" has next to be beaten up into a very fine froth. An American egg-beater may be used, but it is common, when the process is conducted on a large scale, to use a bundle of birch twigs, the bark from which has been removed. In any case the "frothing" must be very thorough, otherwise streaks will be produced on the surface of the paper. When a very thorough froth has been obtained, the vessel containing the albumen (which, by the way, must be many times larger than is sufficient to contain the unfrothed whites) is placed on one side to settle. Probably it will be ready for filtering in about twenty-four hours, but it may be left for several days if desired. It is filtered before use through a couple of thicknesses of muslin.

When floating is to be performed the salted albumen is poured into a flat dish, as already mentioned, to a depth of not less than quarter of an inch. The two faults liable to occur in floating the sheets are air bubbles, which form spots, having on them neither albumen nor salt, and therefore, of course, practically unsensitisable, and streaks formed by unsteadiness in lowering the paper on to the albumen.

It is commonly directed to hold the paper by opposite corners, allowing it to bag or sag down in the middle, to allow it to touch the albumen along the line of the bottom of the sag, and then to lower the two corners simultaneously. I scarcely think, however, that this is the best method of working, as air bubbles are particularly liable to be formed.

It is somewhat difficult to describe methods of manipulation in writing, but I shall endeavour, by the aid of a couple of cuts, to make clear what I consider to be the best method of floating paper either on albumen or on a sensitising bath.

In both cuts C D is supposed to be the dish of albumen; A B the sheet to be floated.

The operator stands at the end C of the dish facing it.

The end A of the sheet is held in the left hand, whilst with the right hand the edge B is turned up as shown in Fig. 1, and is thus brought into contact with the albumen.

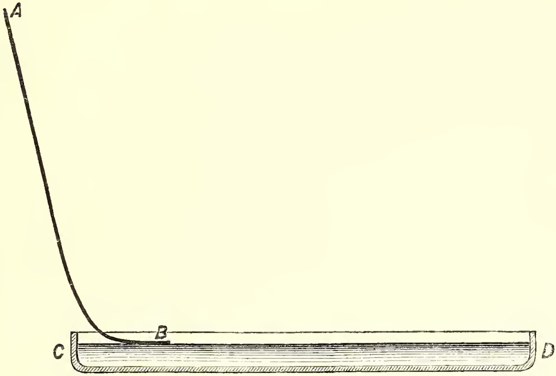



Fig. 1.

The end A is then slowly and quite steadily lowered, whilst the end B is, so to speak, pushed along the surface of the albumen till, just before the process is complete, the sheet assumes the form shown in Fig. 2.

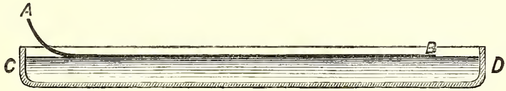



Fig. 2.

It is well not to have the paper excessively dry before floating, otherwise it will have a strong tendency to curl away from the albumen at the edges. If it have been kept


Fig. 3.

for a few days in a cellar of not extraordinary dampness, it will probably be in good condition. Should it nevertheless curl away from the albumen, it may be made to lie flat by gently breathing on the back of it; but the best plan is to have some little blocks of wood, say 2 inches × $\frac{1}{2}$ inch × $\frac{1}{4}$ inch, to lay on the back of the paper and catch the curling edge, as shown in Fig. 3, where A and B show the little blocks.

At the end of about a minute, or whenever the tendency to curl is over, if the time required be more than a minute, the paper is taken by two adjacent corners, and is drawn with an even motion off the albumen. It is then hung up to dry, by placing it, albumenised side outwards, across a roller of wood of such a thickness that there is no tendency to fold. Two inches or so is about the best diameter for the rollers. The paper should be placed in a warm and well-ventilated room to dry. The warmth is especially necessary if a high gloss be desired. Indeed, in this case, a temperature of 80° or even more is not at all too great.

The paper in drying tends to curl towards the albumenised side. It may, when quite dry, be straightened by rolling it up in the manner already described for prints,[1] but as, on account of the difficulty there is in afterwards floating albumenised paper which has been rolled up, it should, in the writer's opinion, never be rolled up at all, —that is to say, till after it is sensitised. The sheets may be laid face downwards and carefully flattened out one at a time by hand, one being placed over another, and eventually a board may be placed on the pile with a weight on the top.

In working on a large scale albumen may be purchased from egg merchants, who dispose of the yolks of eggs to confectioners,[2] or the eggs may be purchased, kept a few days and cracked, and the yolks may be sold to the confectioners.[3]

It is customary in this country to use fresh albumen; but the smell of some foreign papers proves conclusively that the albumen used is not fresh, and these papers some-

[1] See Chap. VI. p. 55.

[2] Abney and Robinson's *Silver Printing*.

[3] George Dawson, *British Journal of Photography*, September 10, 1886.

times give particularly fine results. The gloss is very high, the prints are exceedingly rich, and tone to an excellent colour. It is commonly supposed that these papers are floated on putrid albumen, but the writer feels convinced that this statement is not strictly correct. That the albumen has undergone some decomposition appears certain, but that it is not a decomposition analogous to putrefaction appears from the fact that the smell although disagreeable enough, is very different from the well-known "rotten eggs'" smell. Moreover, the writer's experiments with albumen simply allowed to get putrid have resulted in something in no way approaching the samples of albumenised papers already referred to.

I have been told by Otto Schölzig that the result is produced by *fermenting* the albumen, which is an altogether different thing from allowing it to become putrid. I am, however, unable to give any details of the process.

If it be desired to give a tint to albumenised paper, a little colour is introduced in the albumen, enough to give the desired tint. Aniline colours are commonly used. I have been told by W. Ashman that Judson's dyes answer very well.

Double albumenised paper is produced by floating each sheet twice on the albumen. To prevent the coating acquired by the first floating from being dissolved off on floating a second time, it is necessary to coagulate it. This used generally to be done with damp heat by the aid of steam, but I believe that alcohol is now commonly used. At any rate it is quite efficient. The sheets being once floated and dried, are floated on, or dipped in a mixture of 4 parts of methylated spirits to 1 of water. To float on this is difficult, and I advise that any one, experimenting in this direction, dip the sheet entirely, although thereby there is some waste of spirit. The paper is once more dried and is then floated a second time.

It is not necessary that the albumen for the first floating be salted at all.[1] Indeed, there would appear to be a

[1] George Dawson, *British Journal of Photography*, September 10, 1886.

distinct advantage in not floating it, as thereby the image is kept entirely on the surface of the paper, which is one of the chief objects in double albumenising. I am aware, however, that in some excellent brands of double albumenised paper both coatings of albumen are salted.

Much of the paper sold as double albumenised is in reality only single albumenised. This can readily be proved by placing a piece of it in cold water, when all the albumen will be washed away, showing that there is no film of coagulated albumen.

# CHAPTER VIII

## SILVER PRINTING—*Continued*

### *The Sensitising Bath*

The so-called silver bath or sensitising bath for albumenised paper is simply a neutral solution of nitrate of silver.

The strength of the solution is of some importance. In the very early days of silver printing, baths of what would now be considered of enormous strength were used. Some twenty years ago there was a reaction, and baths of very great weakness were the fashion. A happy medium appears now to have been struck, and there is no reason to suppose that it will soon require revision.

It is customary to state the strengths of sensitising baths in terms of "grains to the ounce," the meaning of this being that there are so many grains of the silver nitrate contained in each ounce of the sensitising bath. This is certainly far from being a scientific manner of stating strengths of solution, but as, in the case of a sensitising bath, a small percentage of error has no perceptible influence on results, and as most photographers are still more accustomed to manipulate grains and ounces than grammes and cubic centimetres, I give strengths in grains and ounces.

The older formulæ for sensitising baths used to give quantities up to 120 grains to the ounce. The weak baths of the period of reaction went as low as 20 grains to the ounce, or, I believe, sometimes even lower. At the present day it is customary to recommend strengths of bath from 40 to 60 grains to the ounce.

The bath ought, according to certain theories, to vary somewhat with the amount of salt used in the albumen, with which the paper is coated, being stronger the greater the quantity of salt; but I must confess that, working within the limits of salting now common, and within the limits of sensitising bath just mentioned, I have not found any appreciable benefit to arise from varying the strength of the sensitising bath with the amount of salt in the paper. On the contrary, I have sometimes found that a comparatively strongly salted paper gave a better result with a 40-grain bath than with a 60-grain, and a comparatively weakly salted paper a better result with the stronger bath.

The best course to pursue in determining at what strength to work is, I think, to take the word of the albumeniser as to the strength of bath that it is best to use, bearing in mind that, whatever he says, it is probably best never to go below 40 grains, whilst it is never necessary to go above 60,—that is to say, for the ordinary run of work. I shall have a word or two to say afterwards on variations of the bath for what may be called abnormal negatives.

If the albumeniser be unable to give any decided opinion as to the best strength of the bath, or, indeed, in any case if much paper requires to be sensitised, it is advisable to settle the matter experimentally by sensitising small pieces of paper on each of these experimental baths made up respectively to 40, 50, and 60 grains to the ounce, printing each under the same negative—one of good standard quality—finishing the prints, and comparing the results.

The strength of the bath being determined, there need be no difficulty in mixing it up. If distilled water be at hand it is well to use such; but if time be given for the precipitate which is formed to settle, any tap-water, of not more than ordinary impurity, may be used.

It is a good thing to have a larger quantity of silver solution than is absolutely necessary to cover the bottom of the sensitising bath. I advise, for whole sheets, not less than a gallon, and a smaller quantity in proportion to the size of smaller dishes. For reasons mentioned hereafter it is advisable to have much more solution even than that mentioned if, as is the case in very large establishments, the sensitising is a continual and daily process.

The bath once mixed up is ready for use immediately, if it has been made up with distilled water; if tap-water has been used, after the precipitate which has been formed has had time to subside, the *bottle containing the solution remaining during the subsidence in bright sunshine if possible.*

So far all is easy; but a bath is liable, after use, to deteriorate in various ways. Thus, for example, a certain amount of the solution is licked up by every sheet floated; but more than this, the remaining solution is left somewhat weaker after every operation. Then, again, a certain amount of organic matter is dissolved by the bath from the albumen of the paper used; still further, there is, at times, a tendency on the part of the bath to become acid, which results in a fatal deterioration in the quality of the paper sensitised on it.

To check the tendency on the part of the bath to become weaker, it is necessary to add a little silver nitrate from time to time. The best way in which to do this is to keep a stock solution of a strength twice that of the bath. A solution of 100 grains to the ounce, for example, for a 50-grain bath, and to add at the rate of quarter of an ounce of this for every sheet sensitised. If a very small quantity of bath (say only 1 pint) be used, the strong solution should be added (quarter of an ounce) after a single sheet has been sensitised. On the other hand, if there be a gallon of solution, it is sufficient to add to it (2 ounces) after the sensitising of every eight sheets.

The quantity of silver nitrate just mentioned will, if regularly added, keep both the strength and the amount of the bath fairly uniform, but there will still be a slight residuary variation. Probably both the strength and the quantity will slightly decline. In any case it is necessary to make an estimation of the strength of the bath from time to time. Certainly an estimation should be made after a quire of paper has been floated on each pint of solution. It were better to perform the operation oftener.

Instruments entitled argentometers are sold for the purpose of estimating the strengths of silver baths. They are simply hydrometers rather roughly made. They are floated in a little of the sensitising solution placed in a small, tall jar, and the strength in grains to the ounce is at once read off on the stalk of the argentometer. These are very useful instruments for estimating the strengths of newly-prepared baths; but I must say at once that, for estimating the strength of a bath which has been much used, and which contains a large quantity of nitrate of ammonium, or rather soluble nitrate in it, besides the nitrate of silver, the argentometer is absolutely useless. The only method to pursue is the volumetric method, and I wish to emphasise this strongly—by following instructions it is perfectly easy for any one, even absolutely ignorant of chemistry, to make a volumetric estimation exact enough for the requirements of a sensitising bath, and he who will not go to the trouble of making such may at once give over all idea of working with anything like the highest success or with uniformity.

The necessities for an estimation, quite nice enough for our purpose, are a burette holding 1000 grains of water, and a pipette holding 1 dram. A burette is simply a graduated tube, with a tap at its lower end, the zero being near *the top*, so that the quantity *run out* is read, not the quantity left in the tube. The burette is fixed so as to stand vertically. The pipette is a glass tube with an enlargement blown on it. It is drawn to a finish point at one end, and there is a mark on the portion of the tube between the enlargement or bulb and the end not drawn to a point. The pointed end is placed in any liquid, and the liquid is sucked up to the mark by applying the mouth to the other end. The result is that we have a small quantity of liquid very precisely measured off. The upper end of the pipette is stopped with the finger. By this means the liquid is retained in it till the finger is removed, when it will flow out into any vessel at will.

The following solutions are now prepared :—

| | | | |
|---|---|---|---|
| A | Distilled water | $22\frac{3}{4}$ | ounces |
| | Bromide of potassium | $87\frac{1}{2}$ | grains |
| B | Water | 1 | ounce |
| | Chromate of potassium | 10 | grains |

When it is desired to make an estimation, a dram of the bath solution is taken from the bath by means of the pipette and is placed in a white vessel—a teacup does excellently—about an ounce of water is poured over this, and then 1 drop of B solution. This 1 drop will probably turn the solution bright red. If it do not, more of the solution must be added drop by drop till the mixture is clearly red, but no more than is necessary to produce a distinct red colour must be used.

The burette is filled up to the zero line with A solution, and the tap being opened, the liquid is allowed to pour into the cup with constant stirring. It will be observed that, as the solution from the burette touches the liquid in the cup, the red colour is discharged, but as stirring goes on it returns; when, however, a certain point arrives, the return is very slow. The top of the burette must now be half closed so that the solution only drops into the cup. Immediately that the red colour has been permanently banished, the tap is closed, and the number opposite the surface in the burette is read off, bearing in mind always that the numbers read downwards. Each ten figures now read 1 grain to each ounce of bath, each one figure $\frac{1}{10}$ grain. Thus if we read off 475 on the burette, it means that the strength of our bath is 47·5 or $47\frac{1}{2}$ grains to the ounce, and so, if it had originally been of a strength of 50 grains to the ounce, it requires strengthening by $2\frac{1}{2}$ grains of silver nitrate to each ounce.

The process, as described in writing, seems complicated, but it is far from being so. The writer has seen a girl go through it entirely by rule of thumb within a couple of minutes at the end of a day's sensitising.

There is a still simpler method of finding out, not the precise strength of a bath, but whether it is up to or above a certain standard. All that is wanted in the way of apparatus is a small pipette. The exact size does not matter. The smaller the better, as there is less of the silver bath wasted in the testing.

A standard testing solution is made up of 7 grains of bromide of potassium for every 10 grains of nitrate of silver in the sensitising bath when up to standard. Thus if it be desired to keep the bath at 50 grains to the ounce, the testing solution is to be made up to 35 grains.

The fill of the pipette of the testing solution is poured into a white vessel, and over it some twenty or thirty times as much water as the pipette holds, and a few drops of the chromate of potash solution. The pipette is thoroughly cleaned, and is refilled this time with the bath solution, which is now allowed to pour drop by drop into the white vessel with constant stirring. As each drop touches the surface of the liquid a red stain is produced, which, however, at first quickly vanishes with the stirring, but after a time more slowly. At a certain point the red discoloration refuses to go at all. If this point is reached *before* the pipette is empty, it proves that the bath is *more than* up to strength. If a few more drops of silver solution have to be added before the red colour becomes permanent, this *proves that the bath requires strengthening.*

After some practice it is easy to guess pretty well how much too strong or too weak the bath is, but, of course, the method can by no means be termed an exact one for determining anything beyond the fact that the bath is too strong or too weak, or is of the normal strength.

Next as to the tendency of the bath to become acid. Fortunately there is a very easy way of preventing this. It depends on the fact that carbonate of silver is insoluble in water or in a solution of nitrate of silver, but is in so far an insoluble salt that almost any acid will replace the carbonic acid of the carbonate, freeing the latter acid in the form of carbonic acid, as in which form it is free to escape, and producing a neutral salt. Or, as it is commonly put, carbonate of silver is insoluble in water, but is soluble in an acid neutralising it. It is from this evident that if we have carbonate of silver in our bath, it will remain as an insoluble and innocuous precipitate so long as the bath is neutral, but will at once be used up in neutralising any acid which may be introduced.

If a solution of carbonate of potash or soda be added to a solution of nitrate of silver, the result is to throw down a precipitate of carbonate of silver. All that we have to do then to keep our sensitising bath neutral is to pour into it from time to time a few drops of a solution of (say) carbonate of soda, so that there is an appreciable amount of precipitate at the bottom of the stock bottle, and from time to time to shake up this precipitate and allow it to settle again.

Fortunately the carbonate of silver also forms a medium for the precipitation of organic matter which may be dissolved in the sensitising bath. If such a bath be "sunned,"—that is to say, be placed in a bottle of colourless glass in a bright light,—the organic matter will be oxidised so long as the solution is not acid, a black, dirty-looking powdery deposit being the result. If there be present in the solution carbonate of silver in a fine state of division, this, in settling down, will carry the oxidised organic matter with it.

To keep our bath free from both acid and organic matter, it is then only necessary to keep always at the bottom of the stock bottle an appreciable amount of carbonate of silver (produced by pouring a little carbonate of soda into the solution), and occasionally to shake this up with the liquid, and place the latter in the brightest light available, pure sunshine if possible.

When, after the bath has had a good deal of use, and the deposit of carbonate of silver and organic matter assumes the form of a black mass, the solution should be filtered, the filtrate being, of course, added to the silver.

In those cases where sensitising goes on from morning till evening, as in some very large establishments, it is advisable to have at least one bath in work and one at rest in the sun. I know, at any rate, one case in which a sensitiser keeps a number of baths continually going, and for each at work keeps two at rest.

Working baths as I have described, I believe that there is no reason why a bath should ever break down altogether. It is true that there is a certain accumulation of soluble nitrate other than the silver nitrate (generally nitrate of ammonium) in the bath, but after a time this reaches a maximum beyond which it will not pass, and, so far as I can judge, even when this point is reached, the bath works no worse than when new. A method will, however, be given further on of precipitating and redissolving a bath should it for any reason refuse, even after the treatment described, to give good results.

# CHAPTER IX

## SILVER PRINTING—*Continued*

### *Floating and Drying Albumenised Paper*

The "silver bath" has been already described, and directions have been given for making it and keeping it in good condition. All that remains is to describe the method of sensitising the albumenised paper, or of "floating," as it is commonly called.

In the first place, as regards the condition of the paper before it is laid on the surface of the bath. It should not be exceedingly dry, otherwise a great difficulty will be found in causing it to lie flat on the surface of the bath. It is a common thing to advise that the paper be kept in a damp cellar for several hours, or even a day or two, before it is floated. There can be no doubt that if this advice be taken, the paper will be in the best possible condition for floating after it comes from the cellar; but it is not every one who has the use of such a place, and in any case it is a somewhat cumbrous manner of performing the damping. The way in which the writer has performed this operation is as follows:—The paper to be floated is placed on a shelf of any cupboard that can be devoted to the purpose—of course, where much paper is manipulated, it will be a small affair to construct such a cupboard—and under the shelf, on the floor or bottom of the cupboard, is placed a dish or bowl of boiling water. The steam or vapour soon diffuses through the whole of the cupboard and slightly damps the uppermost sheet of the paper on the shelf. The paper requires to be laid face downwards, otherwise it is liable to curl up. As the operation of floating goes on, the hot water in the dish may be renewed every half hour, or as often as may appear necessary to keep the top sheet of paper always a little damp.

It is to be understood that no artificial damping—either in a damp cellar or anywhere else—is absolutely necessary for albumenised paper before it is floated. It is only to be considered that if damping be not resorted to, the trouble of floating will be greatly increased.

The size of paper that is to be floated is a matter for some consideration. As a matter of course, where printing is performed on a large scale, a whole sheet, measuring about 22 × 17 inches, will be floated at once; but when only a comparatively small quantity of paper is required for printing, the first cost of dishes of the size necessary to permit of the floating of a sheet 22 × 17, and of the solution necessary to fill such dishes, may certainly be considered excessive.

Those who print on a comparatively small scale, and who therefore incline to float smaller than whole sheets at a time, should be regulated by the possibility of cutting the paper up into useful sizes after sensitising in their choice of a size. It is to be borne in mind in this connection that it is always less wasteful to trim something off the paper before sensitising than afterwards. Thus, if the size to be worked be 10 × 8, and it be decided to float pieces which will cut into two prints of that size, it will be seen that only two pieces for floating can be got out of half a sheet. But the size of a half sheet is about 17 × 11, whereas all that is wanted is 16 × 10, or even somewhat less than that if we consider that it is seldom possible to print quite up to the edge of a negative. It is therefore an economy (although it results in the waste of some albumenised paper) to trim an inch off each of two edges of the half sheets.

It is a common custom with dealers to send out small quantities of albumenised paper in the form of a roll. There is no objection to this so long as the paper is not to be floated in sizes larger than about quarter sheet; but if it be intended to float whole or even half sheets, the difficulty will be enormously increased if the paper has been rolled up. The operator should therefore be careful to desire that the paper be sent out flat. It always is so sent out when any considerable quantity is purchased.

Concerning the actual action of floating I cannot do better than refer to the chapter on albumenising. The paper may be floated on the silver bath in precisely the same way in which it is floated on the albumen (see Chapter VII.) There are also the same precautions to be taken in preventing it from curling up on the surface of the liquid, so that the edges turn on to the back of the paper, and to discover the presence of air bubbles. The paper should not, however, curl away much from the liquid if it have been damped as described, and air bubbles are much less liable to occur when the bath is kept free from organic matter than when it is not.

After the paper has been floated for about half an hour, or till such time as the tendency to curl, it is lifted to see if any air bubbles adhere to it. If they do, they are caused to creep to the edge by laying the paper down on the bath very slowly, or, if this be found impossible, they are broken by the aid of a quill or a glass rod.

The time of floating is one to which it is necessary to give some attention. The time necessary to convert the whole of the salt of the paper into chloride of silver, and also to form an organic compound with the albumen, varies considerably with circumstances. Thus it varies with the strength of the silver bath, but it sometimes comes about that a strong bath requires a *longer* time of floating than a weak one. The reason of this is that nitrate of silver has the effect of coagulating albumen—otherwise soluble in cold water—and that if the bath be very strong in silver nitrate, the coagulation of the surface is very rapid, and considerable time is required for any solution to penetrate the nearly impermeable film thus produced. The conditions are, however, very complex, and it is not at any time possible to tell for certain whether strengthening the bath may necessitate a longer or a shorter time of floating, especially as one item to be considered is the amount of salt in the film which determines the quantity of silver nitrate which must penetrate the surface of the film.

Again temperature greatly influences the time taken for floating. Most chemical reactions proceed more rapidly at a high than at a low temperature, and the sensitising of paper is no exception to the rule. When I say that with a 50-grain bath, with the average of papers in the market, and with a temperature of 50 or 60 degrees, three minutes' floating will give an excellent result, the statement cannot be taken as an absolute one, but only as a general one.

It is very easy, however, to make a test to discover when the sensitising is complete, and as this test once performed the operator may give continually the same time of floating so long as the conditions remain constant, and be assured that he is giving the best length of time, I think it a pity that a printer should ever start sensitising under new conditions without making such a test.

All that is necessary for the test is a solution of a few grains of chromate of potash to an ounce of water, and a small hair-pencil, with which a little of this solution may be brushed on to the back of a sheet of paper.

A drop of the solution is brushed on to the very corner of the first sheet to be sensitised, or is brushed on to the centre of a small piece of albumenised paper devoted entirely to the test.

The chromate of potash is yellow, and makes a lemon-coloured stain on the back of the paper; after a minute or two, however, this stain begins to darken, proving that free silver nitrate has penetrated the albumen film, and is combining with the chromic acid of the chromate of potassium to form chromate of silver, which is of a deep red colour.

The spot will eventually become quite deep ruby in colour, but it may be taken that, when it has acquired an orange colour, the sensitising may be considered as complete. The time occupied between the floating of the paper and the change of colour of the spot to orange is observed, and this is the right time for floating.

The floating complete, the paper must be removed from the bath, and it is desirable to remove it so that it takes as little as possible of the bath solution with it. There are two ways of accomplishing this. One is to draw the sheet over a glass rod placed across one end of the bath; another method, and one better, although it occupies more time, is simply to lift up the paper very slowly, which method will give as good a result as can be got in the way of economy.

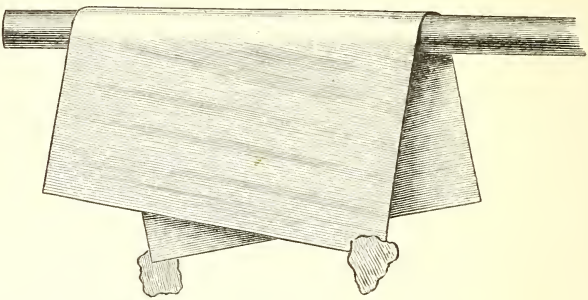
The paper is next hung up to dry. No special application of heat is necessary in drying, but the room in which the operation is performed—which may be the same as that in which sensitising goes on—should be well ventilated, and should never be allowed to get very cold. In fact, the temperature should never be allowed to fall below 50° F. There is no objection to an open fire in the room. Indeed, it is rather an advantage than otherwise.

When paper is sensitised in large pieces—half a sheet or larger—it is best to hang it over rollers or thick cords, with the albumenised side outwards, to dry. When it is in smaller pieces than half sheet, it is liable to curl up so strongly in drying as to fall off the cord altogether. In this case it is best to hang it up by one corner either by a pin to the edge of a table, shelf, or other board, or to a lath, or to hang it (also by one corner) to a line by an American clip.

It is a question whether or not the paper should be "blotted off" before it is hung up, photographers differing somewhat on this point. The writer's opinion is that there is great convenience in so doing, at any rate if the following instructions be attended to, even if it only be from the saving of trouble that arises from having a number of sheets or pieces of paper hanging up all at different stages of dryness, and any one of them requiring at any time to be attended to, to prevent it from curling up into a perfectly unmanageable state, as is the case when the sheets are hung up just as they come from the bath.

Either drying boards (already described) or sheets of blotting-paper guaranteed chemically pure are used. The size should be somewhat over that of the paper to be sensitised.

The sheet, as it comes from the sensitising bath, is laid face downwards on a sheet of the blotting-paper, another sheet of blotting-paper goes on the back of the sheet of sensitised paper, another sheet of sensitised paper (face downwards) on the top of this, and so on till the sensitising is done. A board and weight is then laid on the top of all for a few minutes, and the sheets are taken out—the pile having first been turned upside-down, so that those last sensitised get a little longer blotting than they otherwise would—after which it will be found that they are but slightly damp. They are then hung up either over rollers or by the corners as already described.



It is to be noted that in the case of paper of very high surface blotting off is almost necessary, as otherwise the liquid runs into drops, or, as it is generally said, into "tears," which leave spots printing darker than the rest of the print.

The blotting boards may be used over and over again till they refuse to act properly, when they are placed amongst other residue.

If the operator object to blot off, he may hang the sheets up to dry immediately that they come from the bath, in which case a small fragment of blotting-paper should be caused to touch the lower corner or corners of the paper. This will absorb some few drops of bath solution which would otherwise drop on to the floor. When a piece of paper is hung over a roller—unblotted—it should be hung somewhat on the "skew." This will have the result of causing the liquid to flow to two corners, to which are applied the pieces of blotting-paper. The accompanying sketch will explain what is meant.

The paper, whether it has been blotted off or not, must, after it has dried so much that it begins to curl badly, be treated in some way to flatten it, or at least to make it manageable. It is the custom with some to lay the sheets on the top of each other in a pile with a weight on the top; but this operation is difficult, and leaves a mass of paper not quite dry, and in such a form that it will not speedily become quite dry.

The writer has succeeded best by rolling the paper albumenised side outwards on a roller, causing the beginning of one sheet to lap under the end of the one that is to come next, as already described for albumenised paper. Twenty sheets or pieces are so rolled up with a piece of plain, or still better, albumenised but not sensitised paper round the whole.

I must not omit to describe a method of rendering sensitised paper manageable.

The paper, dried so far as is possible without its becoming unmanageable, is rolled within a continuous roll of plain paper. The operation is performed in the following manner:—

A continuous roll of any ordinary white paper, somewhat broader than the sheets to be sensitised, is procured. The end of this is rolled on to a wooden roller for a few turns, then a sheet of the sensitised paper is laid face downwards on that portion of the plain paper which lies between the two rolls, and the rolling on to the second roller being continued, the sensitised paper is carried in with the continuous roll of plain paper. After all the paper has been passed into the roller, and the whole has stood for an hour or two, the continuous paper is unrolled, and the sensitised sheets, as they come out, are laid in a pile. The continuous paper should be thoroughly desiccated after each operation by rolling it from one roller to another in front of a hot fire.

# CHAPTER X

## SILVER PRINTING—*Continued*

### *Printing, Toning, Fixing, etc., of Paper Sensitised on a Neutral Bath*

The printing of paper prepared at home on a neutral bath is performed in precisely the same way as is printing on preserved paper; but it will generally be found that the process proceeds rather more slowly, and that, moreover, the printing must generally be carried slightly further, as prints on ordinary paper lose, as a rule, a little more than do prints on preserved paper. It is, moreover, to be observed that when, as is sometimes the case in very dull weather, especially in London, the prints take a very long time in the frames, it is necessary to keep a piece of soda-steeped blotting-paper behind each, or otherwise they will be spoiled through the spontaneous darkening of the paper. It is usual to tone the prints on the paper we are speaking of, on the same day in which they are printed, but if they be replaced between the sheets of soda blotting-paper they may be left for some days. Paper once printed—and especially where no quite pure high lights are left—has less tendency to darken spontaneously than that which has not been printed.

The first thing to be observed in connection with the toning and fixing of paper sensitised in the ordinary way on a neutral bath is, that there is much more silver washed out of it in the washings before toning than in the case of, at any rate, by far the greater number of brands of ready sensitised paper. It is for this reason worth the trouble to keep at least the first two washing waters for the sake of the silver they contain. For the same reason it is desirable to get the first two washings over as quickly as possible, there being a possibility that the whites of the prints will turn yellow if they be left for any length of time in a somewhat strong silver nitrate solution—especially if they be allowed to stick together.

Prints on home sensitised paper are generally, as they come from the frames, of a much bluer colour than those on preserved paper, indeed they are sometimes of so deep a blue or purple as to appear as if they were already quite deeply toned. And it is obvious that there would, in this case, be great difficulty in observing the change which takes place in the toning bath.

Very frequently the prints turn reddish during the washing; but if, during the first two or three changes of water, no change in the colour of the prints takes place, it is necessary to have recourse to some way of bringing it about. The simplest way in which to do this is to put a little common salt into the next washing water. A very little will do—about half an ounce to the gallon is sufficient.

It will be observed of paper prepared on a neutral bath that it is much easier with it to get a purple tone than with preserved paper. In fact, it may be said that, whereas a brown colour is most readily got with preserved paper, and is, as a rule, the best colour that can be obtained with it, a purple is most easily got with paper prepared on a neutral bath, and that this is generally the best colour that can be got. No special precaution is necessary, nor any treatment with soda, as in the case of preserved paper. The toning operation is simply pushed until the purple tone is reached. Indeed, in the case of many brands of paper, especially if sensitised on a fairly strong bath—say one of 60 grains to the ounce—the process may be pushed till an engraving black tone is reached.

If, on the other hand, it be desired to get a warm brown with this paper, the prints should be treated after they have had three or four washings with a strong solution of salt. Several ounces of salt to the gallon of water may be used; but at any rate a solution so strong must be made up that the colour of the image turns to a bright red.

It is probable that rather less gold will be used up by the home-made paper than by the preserved; but the writer's opinion is that there is less difference than is commonly supposed. It is certain that the operation of toning goes on much more rapidly—that the print darkens more quickly; but this is no proof that less gold is being used up.

After toning, the operations of washing, fixing, and again washing, are exactly the same as those described for ready sensitised or preserved paper.

It is to be understood that the same bath may be used for paper prepared on a neutral bath as for preserved paper; but as the toning generally proceeds more rapidly, it may be desirable to add more water.

It should always be understood that the formulæ given for toning are to be taken as approximate only. The amount of salt—neutral or alkaline—added, such as borax, for example, is generally fixed only by rule of thumb, and may be varied considerably without producing any appreciable variation on the results. Again, as to the amount of water, or of dilution of the solution, this also can only be determined by experiment. It will be understood that the more dilute the solution the slower the action, that very quick action is to be avoided as it commonly leads to inferior tones, and that too slow action is to be avoided on account of the waste of time involved. If the strength of the solution be so adjusted that toning is complete in any time between about eight minutes and twenty minutes, the best results may be looked for.

# CHAPTER XI

## SILVER PRINTING—*Continued*

### *Storing Paper Prepared on a Neutral Bath, Fuming, etc.*

When paper has been prepared, as described in the last chapter, it will not keep as well as the preserved paper sold by the dealers. In a certain comparatively short period of time it will, without the action of light, turn more or less dark. The time that it will keep without any special precautions varies greatly with circumstances. Thus the weather modifies the time greatly. In hot, damp weather paper will not keep nearly so long as in cool, dry weather. Again, the purity or impurity of the atmosphere has much to do with the length of time that paper will keep. For example, in the air of London paper turns dark more quickly than in the country, probably on account of the sulphur from the burning of coal. But the thing that has the greatest influence of all is the condition of the sensitising bath as regards purity. If this be much contaminated with organic matter there is little chance that the paper will keep good for more than twenty-four hours, if so long. Indeed, with all the conditions unfavourable, sensitised albumenised paper will not remain white for more than an hour or two.

On the other hand, with the conditions all favourable, but without any special provision for preserving it, such paper will remain white for a week or ten days. In the case of ordinary everyday work, in average circumstances, paper may be depended on not to discolour to a degree which would make it useless in less than forty-eight hours; but it is usual, when it is not preserved in any special way, to try to have the prints finished within twenty-four hours of the time when the paper is sensitised.

One of the older methods of preserving sensitised albumenised paper is simply to keep it quite dry, in which condition it will keep for weeks. To secure complete dryness it is necessary to use some deliquescent material, which is generally chloride of calcium. The paper is placed in a tin tube with an air-tight lid, or in any other receptacle which is both light-tight and air-tight, and in the same receptacle there is placed some dried chloride of calcium, care being taken that the salt is not allowed to come into contact with the paper, otherwise the latter will be destroyed. A particularly convenient form of tube is made by the Platinotype Company. The lid contains a receptacle filled with asbestos, which has been soaked in a strong solution of chloride of calcium and has been afterwards dried. There is air communication between the receptacle and the body of the tube through a perforated sheet of metal, but the perforations are so fine that the chloride of calcium is quite confined to its own compartment.

Paper that has been thoroughly desiccated, as in the calcium tube, must be allowed to absorb a little moisture before it is placed in the printing-frame, otherwise it will print poorly. It is sufficient to allow it to hang up for half an hour in any atmosphere not abnormally dry; but the best plan is to fume with ammonia, by which operation the paper is certainly made quite as good as paper freshly prepared. The process of fuming will be described a little further on.

The best method of preserving sensitised paper, in the writer's opinion, is to use soda-treated blotting-paper or drying boards.

A solution of carbonate of soda is made by dissolving 2 ounces or thereabouts of washing soda in each pint of water. Into this are dipped a number of sheets of blotting-paper, which are then dried and used as will be directed. If, as is the case with some kinds of blotting-paper, it be found impossible to remove whole, unfolded sheets from the solution, because the paper has become so tender that it tears, the sheets may be doubled before they are placed in the liquid, and being removed folded in two, may be so hung up to dry over a line. Of course, in this case, the drying takes somewhat longer than when they are unfolded.

The sheets, once dry, are ready for use, and may be used over and over again. As the paper is sensitised and dried,—when it has reached the stage where it is just beginning to curl badly,—it is placed between two sheets of the soda paper, and a pile is made of alternate sheets of soda paper and sensitised paper. A weight is placed on the top of all. Paper so treated will keep for weeks, indeed months. I do not know whether the action of the soda has ever been entirely explained, but I have heard it suggested that it acts as a "sulphur trap," preventing sulphur from getting to the sensitised paper from the atmosphere. This theory finds some corroboration in the fact that contact between the sensitised paper and the soda paper does not appear to be necessary to ensure the keeping of the former. If, for example, a roll of sensitised paper be wrapped up securely in soda paper, it will keep white for several weeks.

Ammonia fuming of paper is a practice of many photographers, especially in America. The advocates of fuming hold that the practice results in more brilliant prints. That this is the case with some brands of albumenised paper is quite undeniable, and it may indeed be taken that every brand of albumenised paper will print at its best if, after sensitising and before placing in the frames, it is fumed with ammonia. Another thing that is equally certain is that it will print considerably quicker if fumed. Still further, any difficulty that there may be in toning—and especially in getting purple tones—will pretty certainly be lessened by fuming.

The process of fuming consists simply in exposing the paper, after it has been sensitised and dried, to the action of the fumes of ammonia. Any arrangement which enables these fumes to act uniformly on the surface of the paper acts well. In America it is the custom to use drying boxes in which to dry the paper, and afterwards fume it. Any box or cupboard in which the paper can be hung up in separate sheets will serve the purpose of a fuming-box; a saucer containing a little of liquor ammonia being placed in the bottom of it, and the paper being allowed to remain under the action of the ammonia for as long as is necessary to cause it to print in the frames to a deep and rich purple colour. The time taken will be from three to twenty minutes, according to various circumstances. Some paper requires more fuming than others. Again, the temperature modifies the time required, a shorter time being needed the warmer the weather. Further, as might be expected, the shape and size of the box influences the time required. The question is, however, easily settled by experiment. The paper must be fumed till it prints to a certain purple colour which, once seen, will always be recognised again. It may remain a very considerable time longer than is necessary to produce the desired result under the influence of the ammonia; but it is possible to over-fume, the result being a dull, sunk-in appearance of the print.

The only danger to be guarded against is unequal action of the ammonia, which will produce, in the end, an inequality of tone. If the paper has been rolled up as recommended in the last chapter, or if it has been stored between sheets of soda paper, it may be hung up in the drying box by laying it across rollers or pieces of stout cord with the albumenised side outwards, the lower corners being clipped together with American clips to stop the tendency that there is for the paper to curl towards the albumenised side.

Some operators wash their sensitised paper in order to preserve it. The result of washing is to remove the excess (or the greater part of the excess) of silver nitrate, which is the agent apparently most active in causing the paper spontaneously to darken. A little nitrate of silver must be left in the paper, otherwise brilliant prints cannot be produced even if fuming be resorted to.

The writer's experience is that it is difficult, or, indeed, practically impossible, just to strike the right amount of washing necessary to leave the quantity of silver nitrate required. Either the paper is washed too completely—in which case it will not print vigorously—or it is not sufficiently washed, in which case it will not keep much better than if it had not been washed at all.

It is, however, by no means difficult to wash and re-sensitise on a weak bath if the photographer likes to take the trouble and has enough of dishes and space to work them in. At least three dishes, besides that used for the first sensitising, are required. I shall call the dishes Nos. 1, 2, 3, and 4. No. 1 is the ordinary sensitising bath; No. 2 is a bath filled with clean tap-water; No. 3 the same; No. 4 is a silver bath made up to a strength of 4 or 5 grains of silver nitrate to each ounce.

The paper is floated on No. 1 bath as usual. It is then transferred to No. 2—being simply floated as before. A second sheet is now floated on No. 1. When the time allowed for sensitising is over, the sheet on No. 2 is transferred to No. 3, that on No. 1 is transferred to No. 2, and a new sheet is floated on No. 1. At the end of the next period the sheet on No. 3 is transferred to No. 4, that on No. 2 to No. 3, that on No. 1 to No. 2, and a new sheet is floated. Next time the sheet on No. 1 is hung up, the other three sheets each advance one stage, and so the thing goes on.

After there has been floated to the amount of six sheets (17 × 22) for each pint of water in each of the baths Nos. 2 and 3, bath No. 2 is emptied into the residue tub, bath No. 3 takes its place, bath No. 2 is then filled with clean water, and takes the place of bath No. 3.

For example, if baths Nos. 2 and 3 each contain a gallon (8 pints), forty-eight sheets may be sensitised before any change is made. The contents of bath No. 2 are then poured into the residue tub,—there will probably thus be at least 2 ounces of silver nitrate saved,—bath No. 3 takes the place of bath No. 2, another gallon of water is poured into bath No. 2, and it takes the third place.

Bath No. 4 loses very little silver, but it does lose a little, and it must, therefore, of course, be kept up to strength. It should also be kept neutral like the sensitising bath—in fact, although its tendency to go out of order is very greatly less than that of the sensitising bath, it should be treated in precisely the same manner.

Paper prepared as described should keep white for some weeks if merely kept from light, moisture, and impure air; but it generally requires to be fumed before use. Without fuming, however, it does excellently for hard negatives, giving from such softer prints than are likely to be got from unwashed paper. Paper prepared as directed, by washing and sensitising, will keep better than paper only partially washed, even if the precise amount required be hit upon, because the nitrate of ammonium produced during the first sensitising is quite washed away. This nitrate of ammonium, the writer finds, has a great influence in aiding the spontaneous darkening of paper, besides retarding the printing to quite an appreciable degree.

# CHAPTER XII

## SILVER PRINTING—*Continued*

### *Printing on Plain Paper*

THE use of albumen as a coating for paper has for its object the production of a certain brilliancy and gloss not obtainable but by the use of some substance which seems to keep the image quite on the surface of the paper. That this gloss—or rather, perhaps one should say, the delicacy of detail which accompanies the gloss—is of advantage in the case of very small work can scarcely be denied; but the larger the work the less need is there for the gloss, and indeed many authorities, excellent on the artistic side of photography, hold that any gloss is distinctly inartistic and should be avoided.

However this may be, there can be no doubt that marvellously beautiful pictures may be made on plain, that is, unalbumenised, paper; and, moreover, that such pictures appear to be far more permanent than those on albumenised paper.

The writer has access to a large number of prints taken from thirty to forty years ago. There are some of them on plain paper, and some of them on albumenised; and, indeed, it may be said that there is every gradation between plain paper and what we now know as albumenised paper, because albumen was used in a very different way thirty years ago from that in which it is now used. A greater or less quantity of water was mixed with it, and the gloss was accordingly less or greater—sometimes so slight as to be scarcely perceptible.

Of the prints referred to, it may almost be said that the fading has been proportional to the amount of albumen on the surface; and further, that of the prints on paper the most thoroughly albumenised, scarcely one is other than considerably faded, whilst of those on paper without any albumen at all scarcely any are faded perceptibly, except where they have been mounted on boards. When they are so mounted they have been affixed by the edges only, and these edges are badly faded.

The writer considers it a thing to be deeply regretted that the use of plain paper has gone so completely out of use as it has, and will feel that he has done useful work if his instructions are the means of making any photographer give the old process a trial.

As pointed out by Captain Abney, some idea of the results to be obtained by the use of plain paper may be gained by taking a piece of common albumenised paper and floating it face (albumenised side) *upwards* on the ordinary sensitising bath. The paper must be made distinctly damp before it is floated, otherwise it will curl very badly on the bath. After floating for the usual time, it is dried and printed with the back towards the negative, and is then toned in the ordinary way. If, as is quite likely, the operator finds it impossible to float it in this way, on account of its curling, he may dip it entirely.

Saxe paper is well suited to the production of plain prints. The following method of working has given excellent results in the hands of the writer. It is taken, with very slight modifications, from Hardwich's *Photographic Chemistry*.

In 20 ounces of water there are placed 20 grains of gelatine,—Nelson's No. 1 is suitable,—this is allowed to soak till it has swelled, when the water is heated to dissolve it. There are then added 60 grains of chloride of ammonium.

Saxe paper is soaked in this solution. The time of soaking does not much matter so long as the paper is allowed very thoroughly to soften, and care is taken that no air bubbles adhere to it. It is then allowed to dry—and here it is to be observed that, as the paper is not albumenised, there is not the trouble that there is with the latter kind of paper of continually guarding against its curling up in an unmanageable way.

This paper, when dry, may at once be floated on the ordinary silver bath used for albumenised paper. In this case the chromate test may be used for observing when the sensitising is complete. Very good results can in this manner be obtained, especially from very dense negatives; but the writer has got far better results—especially as regards colour—by using the "ammonia nitrate" bath, prepared precisely as recommended by Hardwich. By its means it is possible to get the richest imaginable purples. The following are Hardwich's instructions:—

"Dissolve 60 grains of nitrate of silver in half an ounce of water, and drop in ammonia until the precipitated oxide of silver is exactly redissolved.[1] Then divide this solution of ammonia nitrate of silver into two equal parts, to one of which add nitric acid cautiously until a piece of immersed litmus paper is reddened by the excess of the acid; then mix the two together, fill up to 1 ounce with water, and filter from the milky deposit of chloride or carbonate of silver, if any be formed.

"Ammonia nitrate of silver should be kept in a dark place, being more prone to reduction than the nitrate of silver."

It is objectionable to *float* paper on an ammonia nitrate bath, as the solution is very liable to be contaminated by such floating, both by organic matter and by the salt of the paper, which causes the liberation of free ammonia, which, in its turn, marks the paper.

For this reason the paper must be damped with a brush. The writer has performed this operation in the following

[1] Liquor ammonia is dropped into the nitrate of silver solution. A black precipitate is at once produced; but as the addition of ammonia continues, the precipitate is redissolved. As the colour begins to lighten, the further addition of ammonia is very carefully made with stirring after each drop is added. If the operation is carefully done, the "ammonia nitrate" solution will barely smell of ammonia.

manner:—A sheet of the paper is pinned by the corners to a clean board. A broad camel's-hair brush, such as is sometimes used for damping the sheets of copying books, is used to brush the liquid over the paper.

The board is slightly inclined, and a liberal supply of the sensitising fluid being taken up by the brush is quickly drawn sideways along the upper edge of the paper. This operation is repeated, each sweep of the brush coming lower down, and when the whole of the surface has been damped, the brush, without further addition of sensitising solution, is used at right angles to the first lines of use; the board being, during this operation, inclined in a different direction from the first time, so that the brush always works in horizontal lines. The board is then placed horizontally for a couple of minutes, when the paper is removed from it and hung up to dry.

Plain paper prepared on the ordinary silver bath will keep just about as well as albumenised paper which has been sensitised; but prepared on the ammonia nitrate bath it keeps very badly. Indeed, if the soda-blotting sheets be not used, it will generally keep for only a few hours.

The plain paper is printed in just the same manner as albumenised paper. That prepared by floating on the ordinary bath will be found to print about as quickly as sensitised-albumenised paper. That prepared on the ammonia nitrate bath will print considerably quicker.

Toning may be performed with the same toning bath as that used for albumenised paper; but the action will take place more quickly in most cases, and for this reason it is generally advisable somewhat to dilute the bath. Probably about 1 grain of chloride of gold to 16 ounces of water will be found to give good results.

Fixing and washing are conducted in the same manner as with prints on albumenised paper.

# CHAPTER XIII

## SILVER PRINTING—*Continued*

### *Various Toning Formulæ—General Remarks on Toning*

THE number of toning formulæ, the use of which has been recommended from time to time, is very great. Many of these are probably merely fanciful variations of others. There are, however, certain formulæ which may be called "standard" formulæ, inasmuch as they have been used by great numbers of photographers for a considerable time, and have each of them adherents who swear by some particular one as against all others.

In the historical sketch at the beginning of the book mention has been made of methods of "sulphur" toning, or toning without the aid of any gold at all. Such methods have not, so far as I am aware, any single adherent at this time, chemists having proved quite conclusively that the results of such toning must be very evanescent, and being in no way shaken in their conclusion from the fact that these results, in the form of very old sulphur-toned prints yet unfaded, appear to show proof of quite as much permanence as is to be found in prints toned by the gold bath.

There are many prints in existence toned with hypo and silver upwards of thirty years ago, which have all the appearance of being as fresh as ever. It is quite possible, however, that this is really due to the fact that at the time referred to, it was the custom to use very dense negatives, a strongly salted paper, and a strong silver nitrate bath, so that prints of great boldness with a very heavy metallic deposit resulted.

The reader may, in any case, like to try a "sulphur" toning bath. This consists essentially of a hyposulphite of soda solution, with dissolved in it a certain quantity of hyposulphite of silver. This latter may be produced by dissolving iodide, bromide, or chloride of silver in the fixing bath, but it is difficult to see that these haloids can have any advantage over nitrate of silver.

The following bath, which is given by Hardwich, has worked well in the writer's hands; but as his experiments have only recently been performed, he cannot give any opinion as to the permanence of the results:—

| | |
|---|---|
| "Nitrate of silver . . . | 3 drams |
| Hyposulphite of soda[1] . . | 4 ounces |
| Water . . . . . . | 8 ounces |

"Dissolve the nitrate of silver in 2 ounces of the water, then from the total quantity of hyposulphite of soda weigh out

"Hyposulphite of soda, 2 drams.

"Dissolve this likewise in 2 ounces of the water, and the remainder of the hyposulphite in the other 4 ounces. Then, having the three solutions in separate vessels, pour the nitrate of silver at once into the 2-ounce solution of hyposulphite, agitating the precipitated hyposulphite of silver rapidly. In a short time it will begin to decompose, passing from white to canary-yellow. *When the orange-yellow begins to verge towards brown* add the 4-ounce concentrated solution of hyposulphite, which will at once complete the decomposition, a part of the precipitate dissolving and the remainder becoming perfectly black. After filtering out the black sulphuret of silver, the solution is ready for use."

This bath will tone but slowly. It is, however, possible, if patience be exercised, to get a very fine black tone.

[1] The writer prefers to use only one-half this quantity of hyposulphite of soda.

The bath may be used over and over again, being only kept up to quantity with a plain hypo solution. Indeed, it improves by use, as silver is added to it by every print that passes through it.

It is advisable to fix the prints in a plain, neutral, or slightly alkaline fixing bath for quarter of an hour after fixing.

### *Toning and Fixing in one Bath*

The following formula for toning and fixing in one bath is taken from the *British Journal Photographic Almanac.* The writer has used it experimentally, and has got good results with it, but prefers to perform the operations separately :—

| | | |
|---|---|---|
| Chloride of gold . . . | 1 | grain |
| Phosphate of soda . . . | 15 | grains |
| Sulphocyanide of ammonium . | 25 | ,, |
| Hyposulphite of soda . . | 240 | ,, |
| Water . . . . . . | 2 | ounces |

The objection to the use of such a bath is that, after a few prints have passed through it, silver is dissolved by the hyposulphite, and may cause toning precisely as in the case of the bath last described, so that it is never possible to be sure how much of the tone given is due to gold, how much to sulphur. This is especially the case if the bath be used several times over.

### *The "Sel d'or" or Toning Process*

This objection does not hold in the case of the *sel d'or* bath now to be described. Although a small quantity of hyposulphite of soda is used, it forms a compound with the gold which is also used, and does not (the writer believes) form hyposulphite of silver with the chloride of silver of the prints.

The *sel d'or* bath was at one time a great favourite, and the substance *sel d'or* was an article of commerce. So far as the writer is aware, however, it is not now to be purchased. It is, however, very easily prepared. The following is the formula given by Hardwich :—

| | |
|---|---|
| Chloride of gold . . . | 1 grain |
| Pure hyposulphite of soda . . | 4 grains |
| Hydrochloric acid . . . | 4 minims |
| Water . . . . . | 4 ounces |

The gold chloride and the hyposulphite of soda are each dissolved in 2 ounces of the water, then the gold solution is poured into the hyposulphite of soda (not *vice versâ*) slowly and with stirring. The hydrochloric acid is then added.

It is quite necessary when using the bath to get rid of all the free silver nitrate of the prints, otherwise the bath will be at once spoiled. This is effected by the use of common salt in one of the washing waters as already described (Chapter V. p. 47).

The bath acts quickly and gives good tones, which must be pushed pretty far, as there is generally a little falling off of colour in the fixing bath. This latter is made up in the ordinary way, but should be made so far alkaline with ammonia that it distinctly smells of this substance, so that the acid carried over by the prints may be immediately neutralised, or, what is better, the prints may be placed directly they are toned for a few seconds in a bath containing about quarter ounce of ammonia to each pint of water. In any case the washing between toning and fixing must be very slight.

### *The Acetate Bath*

The "acetate" toning bath is perhaps, in spite of various drawbacks, the most popular bath at this day, especially with professional photographers, and it is likely that in all cases where toning goes on regularly from day to day it is the best bath that can be used. For those, however, who tone only occasionally, it is inconvenient, as it has to be made up at least twenty-four hours before it is used, if the best results are expected. Indeed some hold that an acetate bath should not be used till it is a week old. The formula is as follows :—

| | | |
|---|---|---|
| Chloride of gold | . . | 1 grain |
| Acetate of soda | . . | 20 to 30 grains |
| Water | . . . . | 12 ounces |

The acetate of soda is dissolved in the water and then the gold is added. It is necessary to keep a considerable quantity of this bath in stock if it be decided to use it, for the reason that there must be enough to tone the largest batch of prints that is ever likely to be toned at one time. When toning is over the solution is not poured away, but is returned to the stock bottle, being, however, previously filtered. The necessity for this arises from the fact that, if any organic matter find its way into the stock bottle, it is liable to precipitate the gold.

When the solution is returned to the bottle, about 1 grain of chloride of gold is added for each sheet, 22 × 17, that has been toned, or if, even with this addition, the bath gradually loses strength, a little more than a grain.

The stock bottle should be kept in a dark place, as light is liable to cause a deposition and consequent loss of the gold.

*The Gold and Phosphate Toning Bath*

This bath is a favourite with many. It has the advantage that it may be mixed up just before it is required; but on the other hand, like most such baths, it will not keep. The formula is as follows :—

| | | |
|---|---|---|
| Chloride of gold | . . . | 1 grain |
| Phosphate of soda | . . . | 20 grains |
| Water | . . . . . | 12 ounces |

It is well in the case of both the last two formulæ to neutralise the gold solution before it is added to the liquid by adding a pinch of powdered chalk to it, and allowing the chalk to settle.

*The Bicarbonate Toning Bath*

It is usual to call the borax, the acetate, and the phosphate toning baths "alkaline" baths; but in reality the name is scarcely applicable, as the salts just mentioned are neutral or as nearly so as possible. The first toning baths were, as has already been mentioned, used without gold at all; next came gold mixed with hyposulphite of soda, then *sel d'or*, and after that an acid gold toning bath. This has not been particularly described, as there are many objections to its use. The next bath that was proposed was the alkaline gold toning bath,—namely, that in which gold was used in conjunction with bicarbonate of soda. This bath has still many adherents, and although, as I have said, other baths have been termed "alkaline," they should more strictly be termed *neutral*, the bicarbonate bath being the only true alkaline bath that I know of. The formula is as follows :—

| | |
|---|---|
| Gold chloride . . . . | 1 grain |
| Bicarbonate of soda . . . | 5 grains |
| Water . . . . . | 12 ounces |

The bath is ready for use immediately that it has been prepared, but will not keep.

### *General Remarks on Toning*

In each of the above formulæ I have given a certain definite quantity of water; but leaving out of the question the hypo and silver fixing bath and the hypo and gold, the amount of water in every bath—including the *sel d'or* —should rather be fixed by experiment than taken as an absolute quantity. It must be borne in mind that some papers tone more readily than others, even if sensitised on a neutral bath, that preserved papers generally take longer to tone than those sensitised on a neutral bath, and that various scarcely understood variations in the toning bath cause differences in the time taken for toning. Now the thing to be aimed at in the composition of a toning bath is that it should bring about the required change neither too slowly nor too quickly. It may be said that toning should never take less than ten minutes, and should perhaps take twice as long to get the best results.

In this connection I would lay great stress on a fact commonly left out of consideration. This is, *that the more gold actually used up in toning the better*, as there is the greater chance of permanency in the results.

As to this matter of permanency I would say a word. There are two different modes of fading; or rather there is a fading, and another entirely different manner of deterioration which should not be called fading at all. The latter consists in a yellowing of the white of the prints. It is a thing very commonly met with, and gives a print an exceedingly disagreeable appearance. It appears to be brought about greatly by damp and sometimes by light. It is certainly due—at least when in at all an aggravated form—to the incomplete fixing of the image,—that is to say, to the imperfect removal of the last trace of the silver in some form or other, probably in combination with sulphur. The action of the fixing bath is to convert the compounds of silver, not acted upon by light, into hyposulphite of silver which is insoluble in water, but is soluble in excess of hyposulphite of soda. For the complete removal of the last trace of silver compound other than what forms the image, three distinct processes are therefore necessary. First, the whole of the silver compounds must be converted into hyposulphite of silver, requiring a certain quantity of hyposulphite of soda; second, this hyposulphite of silver must be dissolved in an excess of hyposulphite of silver, which excess must be large; and thirdly, the last trace of the hyposulphite of soda, containing the hyposulphite of silver in solution, must be washed out of the print.

To secure these objects, the use of an ample quantity of hyposulphite of soda is necessary, and the keeping of the prints in motion all the time they are in the bath, or, still better, the use of *two* fixing baths as already described. But something more is necessary, the baths must on no account be acid, as the presence of any acid seems to result in the formation of some silver compound insoluble in hyposulphite of soda—which silver compound is, I have not the smallest doubt, the most common of all causes of the yellowing of the whites of prints. I believe, indeed, that if prints were always carefully fixed in two baths, each containing a large quantity of a slightly *alkaline* solution of hypo, and were then fairly well washed, no yellowing need occur. Very complete removal of the hypo by washing does not appear to be necessary to prevent *yellowing*, the result of the presence of a trace of hypo being rather to prevent than to produce yellowing, but, on the other hand, to produce an actual fading of the image to be now described.

The image of the print before toning consists of some compound of silver. There is some doubt as to what this compound is;[1] but at any rate it appears to be something by no means very stable, for an image simply washed and fixed without being toned very soon fades, in the sense that the image is actually reduced in depth or intensity.

When, however, we tone the print, what is known as a "substitution process" goes on,—that is to say, a certain portion of the silver compound is replaced by metallic gold. Now gold is, next to carbon, one of the most stable of substances.

It therefore simply stands to reason that the more gold deposited on the image, or, to put it in other words, the greater the proportion of gold forming the image, the greater is the chance of permanency, whilst, could we replace the silver compound entirely by gold, we should have an image of a comparatively very high degree of permanency.

It may be asked why the toning process should not be continued till the substitution *is* complete,—that is say, till the image consists of gold entirely, in a very fine state of division, in which form it may be of any colour from purple to red, according to the degree of fineness of the division of the gold.

The writer is unable to say *why* it should be impossible to carry the process far enough for complete substitution, but the fact remains that before such substitution is complete the picture takes a sunk-in, disagreeable tint, and that, therefore, it is necessary to stop the process whilst

[1] See Chapter XIV. "On the Chemistry of Silver Printing," p. 103.

there is still some considerable amount of silver compound in the image.

Still much may be done to keep the proportion of gold forming the image comparatively high. Thus it may be taken that whenever the toning proceeds very rapidly, the amount of gold deposited, by the time a certain tint is reached, is comparatively small, and the image, therefore, stands a correspondingly small chance of being permanent. Again the presence of free silver nitrate in the paper—as when it is but slightly washed before toning—accelerates, apparently, the change of colour without accelerating much the deposit of gold. In fact, it would seem as though the excess of silver nitrate acted in some way as a silver-toning agent, nor is this a thing at all absurd to suppose, if we consider the action of the hyposulphite of soda and silver toning bath.

It may be said, then, that we increase the quantity of gold required to produce any particular colour by washing out the silver nitrate from the prints as completely as is compatible with the gaining of the tone we require,[1] and by oning slowly. By these means it is certainly possible to produce such a deposit of gold that the removal of all the silver compound scarcely appreciably reduces the depth of the image. This removal—or, what comes to the same thing for the purpose indicated, a bleaching—of the silver portion of the image is a thing very easily done, so that every photographer may easily determine for himself how much of the depth of the image of his silver prints is due to gold, how much to silver.

A saturated solution of bichloride of mercury is made up. If a print fixed, but untoned, be dipped in this, the image will entirely disappear. If, however, a very slightly toned print be dipped in the solution, some of the image will be left. In fact, just that portion of the image that is due to gold is left, whilst that which is due to silver is bleached till it is invisible. If the conditions have been

[1] With some toning baths and some samples of paper a purple tone cannot be got if all the silver nitrate be washed away from the paper.

such that as much gold as possible has been deposited, there may be a slight change of colour of the image, but there will be no perceptible reduction in intensity. In fact, there is a complete image in gold which, in all probability, is very permanent.

If the instructions given in a former chapter be carefully carried out, even a brown image may be made to consist of such a proportion of gold that it is not appreciably reduced by the bichloride of mercury solution.

Of all false photographic economies, the falsest would appear to be that which attempts to save on the amount of gold deposited on the image.

# CHAPTER XIV

## SILVER PRINTING—*Continued*

### *On the Chemistry of the Image of Silver Prints*

No work on printing would be at all complete without some few words on the formation of the image of a silver print. As, however, the writer does not pretend to any extensive knowledge of chemistry, he at once acknowledges his indebtedness to Captain Abney and to Hardwich for the greater part of the following information.

In all silver printing processes the silver is introduced in the form of silver nitrate; but this salt itself is quite insensitive to light, as may be observed by the fact that it will, if pure, remain white for any length of time exposed to the strongest light in colourless glass bottles. In fact if, in the circumstances mentioned, silver nitrate discolour, this fact may, of itself, be taken as proof of the existence of some impurity in the form of some compound of silver, either organic or inorganic, other than nitrate of silver.

In all the silver printing processes yet described, the principal sensitive salt has been chloride of silver, a molecule of which may be supposed to consist of 1 atom of silver and 1 of chlorine, and is represented by the sign $AgCl$.

The relative weights of an atom of silver and one of chlorine are 108 and 35·5. If now we take of any salts one containing silver and the other chlorine such quantities that the weight of the silver in one and of the chlorine in the other are in the relation of 108 to 35·5, we have the quantities necessary for the formation of chloride of silver, and to produce such chloride of silver it is only necessary to take a silver salt, in which the silver is said to have less affinity for the other component of the salt than it has for chlorine, and a chlorine salt, in which the chlorine has less affinity for the other component of the salt than it has for silver, and to bring the salts into close contact (as by dissolving them separately in water and bringing the two solutions together), when chloride of silver will be formed.

If, for example, we take nitrate of silver ($AgNO_3$) and chloride of ammonium ($NH_4Cl$) in the relative quantities, 10 and 3·15, we will have weights of silver (in the nitrate of silver) and chlorine (in the chloride of ammonium) having the relation of 108 to 35·5, and as silver (Ag) has a stronger affinity for chlorine (Cl) than for nitric acid ($NO_3$), and chlorine (Cl) has a stronger affinity for silver (Ag) than for ammonium ($NH_4$), if each of the salts mentioned above be dissolved separately in water in the relative quantities mentioned, and the solution be mixed, the silver (Ag) and the chlorine (Cl) will fly together, forming chloride of silver (AgCl), and leaving over nitric acid ($NO_3$) and ammonium ($NH_4$), which will also combine, forming nitrate of ammonium ($NH_4NO_3$).

This double decomposition and double recombination is represented chemically by the following formula :—

$$\text{Nitrate of silver} + \text{Chloride of ammonium} = \text{Chloride of silver} + \text{Nitrate of ammonium}$$

$$AgNO_3 + NH_4Cl = AgCl + NH_4NO_3$$

Supposing now, however, that the two salts, nitrate of silver and chloride of ammonium, are not precisely in amounts by weight proportionate to 10 and 3·15, but that there is a greater proportionate amount of either one or the other. The double decomposition will go on as before, the two new products being formed, but there will remain over some of one or other of the first compounds besides. To make this clear I shall take actual figures. I shall suppose 11 grains of silver nitrate and 3·15 grains of chloride of ammonium dissolved, the solutions being then mixed. Ten grains of the silver nitrate only will be used up, and besides silver chloride and nitrate of ammonium, there will remain over 1 grain of nitrate of silver. On the other hand, suppose 10 grains of silver nitrate taken, and 4 grains of nitrate of ammonium, there will remain over, besides the chloride of silver and nitrate of ammonium, $4 - 3{\cdot}15 = {\cdot}85$ grain nitrate of ammonium. In the former case there is said to be nitrate of silver in excess or an excess of nitrate of silver, in the latter there is said to be chloride of ammonium in excess or an excess of chloride of ammonium.

As a matter of fact it is practically impossible, even were it desirable, to so adjust the relative weights of two salts as to leave absolutely no excess; but in such a case as the above, where both the initial salts, nitrate of silver and chloride of ammonium, are soluble in water, and where one of the resulting salts, nitrate of ammonium, is also soluble, whilst the other, chloride of silver, is insoluble, the result of mixing the two solutions is to throw down as a *precipitate* the insoluble salt, which may then be *washed*, so that the last trace of the nitrate of ammonium and of whichever of the initial salts was in excess may be got rid of.

The following experiments may be performed to illustrate the formation of chloride of silver, and of the effects of excess of silver nitrate and of chloride of ammonium :—

Twelve grains of silver nitrate are dissolved in water in a test tube. This solution we shall call No. 1, and 3 grains of chloride of ammonium in test tube No. 2. This will give an excess of nitrate of silver.

Ten grains of silver nitrate are dissolved in test tube No. 3, and 5 grains of chloride of ammonium in test tube No. 4. These two latter quantities will give excess of chloride of ammonium.

In each case the amount of water should rather less than half fill the test tube.

The contents of test tube No. 1 are now poured into No. 2, and those of No. 3 into No. 4. In both test tubes No. 2 and No. 4, there will be formed at once a thick, white precipitate. This is chloride of silver. The precipitates will gradually settle, after which the water is poured off.

If now the two test tubes be taken into a strong light, such as sunlight, or even bright diffused light out of doors, the surface of the precipitate will darken in each case, but will darken more rapidly and to a greater extent in the case of the precipitate in No. 2 test tube when there is excess of silver nitrate, than in the case of that in No. 4 when there is excess of bromide of ammonium.

There has been a great deal of discussion as to what the dark substance actually is; but one thing that is quite certain is that its appearance is accompanied by the liberation of chlorine. Captain Abney believes it to be sub-chloride of silver. He believes that every 2 molecules of chloride of silver (AgCl) give up 1 atom of chlorine (Cl) having a molecule of 2 atoms of silver (Ag) and 1 of chlorine, and this compound he calls sub-chloride of silver.

The supposed action is indicated chemically thus—

| | | | | |
|---|---|---|---|---|
| Two molecules of silver chloride | = | One molecule of silver sub-chloride | + | One atom of chlorine |
| $2(AgCl)$ | = | $Ag_2Cl$ | + | $Cl$ |

At any rate of this we may be certain—chlorine is given off. Now this chlorine must go somewhere, and if there be near any substance with which it will readily combine—which will, so to speak, *mop it up* immediately that it is liberated, the action of liberation by light is much more active than it will be if there be no such substance. Nitrate of silver is such a substance, whilst nitrate of ammonium is not, and this is supposed to be the reason why the chloride of silver darkens so much more rapidly in presence of excess of silver nitrate than in presence of excess of nitrate of ammonium.

The excess of silver nitrate has, however, a certain further action, inasmuch as it results not only in a quicker darkening, but to a certain extent, in a different colour from the beginning, the colour being bluer than it is without the nitrate of silver. Concerning this Abney states, "We have the best of reasons for believing that the blue colour is really due to a combination between the sub-chloride and the oxygen contained in the water and in the air."

If the reader now refers to the chapters on albumenising of paper and of sensitising, he will find that the result of these two processes is to produce paper having a film of albumen containing chloride of silver with nitrate of silver in excess. But we have, besides this, the albumen to consider, not as a mere vehicle for the silver chloride, because the albumen itself becomes sensitive, or, more strictly speaking, forms a sensitive compound when treated with nitrate of silver. This is proved by the fact that it is quite possible to get prints of a kind by the use of paper albumenised without any salt at all in the albumen, and is still more conclusively proved by coating a plate of glass with pure albumen, allowing the film to dry, and dipping it for a time into the sensitising bath. We will then have a film quite sensitive to light.

The action of silver nitrate on albumen is very marked. In the first place, it coagulates the albumen, or, in other words, renders it insoluble in water either hot or cold, whereas before it was soluble in cold water. It is true that there are other means—not involving, so far as is known, a new combination—whereby albumen can be coagulated. For example, any damp heat—as, for instance, that of steam—will have the effect. So, also, will the application of alcohol—as already mentioned in connection with "double albumenising" (see Chapter VII.)

But the action of the silver nitrate appears to be not only to coagulate the albumen, but to form an organic compound, to which the name of albumenate of silver has been given.

It is this compound which is acted upon by light in the case of a film of pure albumen which has been acted upon by nitrate of silver; but the precise action of the light upon the albumenate of silver appears to be a very complicated one. At any rate there appears to be no precise information obtainable as to what the image on albumenate of silver consists of. Abney, however, gives very good reasons for supposing it to be a different compound from that produced by decomposition (by the action of light) of chloride of silver, either in the presence of excess of nitrate of silver or in its absence.

We are thus enabled to arrive at the conclusion that the untoned image on albumenised paper consists of two different compounds of silver, the stability of either of which is, at any rate, rather doubtful.

It may be well here to state that so far the remarks made apply in some measure to the gelatino-chloro-citrate printing-out paper to be hereafter mentioned; but by no means entirely, inasmuch as the gelatine in this latter process is at no stage in contact with excess of silver nitrate, and there is probably no compound of gelatine and silver formed. On the other hand there is present citrate of silver, which is possibly reduced by light to a different compound of silver than is chloride of silver. Nevertheless the image gained by printing out on gelatino-citro-chloride coated paper may be looked upon as in many respects similar to that obtained by printing out on albumenised paper.

On the other hand the images produced by the various development processes—to be hereafter described—must be looked on in quite a different light. They are composed, so far as our knowledge goes, of pure metallic silver.

Going back to the consideration of the untoned image on sensitised-albumenised paper, we have to consider the process of toning this somewhat complex image. The subject has already been treated to a certain extent at the end of Chapter XIII., where it has been pointed out that the toning process consists in the substitution of gold in a very fine state of division for the silver, which enters into the combination just mentioned, and where it is insisted that the greater the amount of this substitution the greater is the likelihood of permanency of image.

The image being toned, the object is to remove every trace of the sensitive compounds of silver which have not already been acted upon by light. These are the chloride of silver and the albumenate of silver.

The substance used to dissolve out these compounds—or, as it is generally put, to fix the image—is hyposulphite of soda. This substance does not act directly on the chloride or albumenate of silver, but converts them, first of all, into hyposulphite of silver, which may be soluble in hyposulphite of soda. I say may be, because, according to Abney and others, there are two hyposulphites of silver formed, one, which is soluble, in the presence of an excess of hyposulphite of soda, the other, which is insoluble, in the presence of an excess of the silver compounds. The following formulæ, representing the formation of the two compounds, are copied strictly from *The Art and Practice of Silver Printing*, by Abney and Robinson :—

$$\left.\begin{array}{c}\text{Silver}\\\text{chloride}\end{array}\right\}\text{ and }\left\{\begin{array}{c}\text{Sodium}\\\text{hyposul-}\\\text{phite}\end{array}\right\}\text{ form }\left\{\begin{array}{c}\text{Insoluble}\\\text{double}\\\text{hyposulphite}\\\text{of silver and}\\\text{sodium}\end{array}\right\}\text{ and }\left\{\begin{array}{c}\text{Sodium}\\\text{chloride}\end{array}\right.$$

$$AgCl + Na_2S_2O_3 = AgNaSO_3 + NaCl.$$

$$\left.\begin{array}{c}\text{Silver}\\\text{chloride}\end{array}\right\}\text{ and }\left\{\begin{array}{c}\text{Sodium}\\\text{hyposul-}\\\text{phite}\end{array}\right\}\text{ form }\left\{\begin{array}{c}\text{Soluble}\\\text{double}\\\text{hyposulphite}\\\text{of silver and}\\\text{sodium}\end{array}\right\}\text{ and }\left\{\begin{array}{c}\text{Sodium}\\\text{chloride}\end{array}\right.$$

$$2AgCl + 3Na_2S_2O_3 = Ag_2Na_4 3(S_2O_3) + 2NaCl$$

The first represents the action in presence of excess of silver compound; in other words, when there is much too little hypo used for fixing. The latter represents the action when hypo is in excess, and it is almost unnecessary here to mention that a very large excess of hypo is always desirable when prints are to be fixed, but it is well to lay stress on the desirability, already mentioned, of having the bath distinctly alkaline—to save any chance of its being acid—as an acid solution of hyposulphite of soda forms insoluble compounds of silver, even when the hypo is ever so much in excess, and therefore endangers the permanence of the prints.

### *To Determine the Quantity of Chloride present in a Sheet of Albumenised Paper*

I said that I would describe a method of determining how much chloride has been used on a sheet of albumenised paper, in case the photographer may desire to use the knowledge as a guide to the strength of sensitising bath he will use.

The method is precisely the converse of that used to determine the strength of the sensitising bath, and is very easily practised.

A solution of nitrate of silver is made in distilled water containing $31\cdot\frac{3}{4}$ grains of the salt to each 1000 minims. A sheet of the paper to be tested is cut up into little bits, is placed in a glass measure, and about half a pint of distilled water is poured over it. The paper is allowed to soak for, say, an hour with frequent stirring, when enough chromate of potash is added to make the solution of albumen and chloride slightly yellow. The silver nitrate solution is now poured into a burette holding 1000 minims, and is slowly run into the mixture of paper, water, etc., whilst the latter is stirred. As the silver nitrate solution touches the water, it will produce a red stain which, however, disappears as the stirring goes on. After a time, however, it will disappear more slowly. The addition is now very cautiously made, and just when the red colour becomes quite constant — no amount of further stirring sufficing to drive it off—the burette is read. Every 100 minims means that the sheet of paper was albumenised with albumen containing 1 grain of chloride of ammonium, or the equivalent of some other chloride. Thus, if 672 minims be read, the sheet of paper had 6·72 grains of chloride of ammonium in it.

# CHAPTER XV

## VARIOUS MANIPULATIONS OF CONTACT PRINTING

*Treatment of the Negative before Printing and during Printing —Treatment of Paper to suit certain Negatives*

THERE are very few negatives which will give perfect prints "right away,"—that is to say, placing them at once in printing-frames with paper behind them, and placing them to print in whatever light comes nearest to hand. Almost every negative is improved by a little hand-work of some kind or another, and there are not many which do not absolutely require it.

Of actual retouching, as it is commonly understood, I intend to say no word here. Those who wish to acquire this art may consult Mr. Robert Johnson's book, which appeared in the same series as this book appears in.[1]

The kind of defects which can be remedied without actual retouching with the pencil on the film side of the negative are such as show certain considerable portions of the prints too light or too dark. These defects may be only local, requiring that a certain light be either made lighter or darker, or that a particular shadow be made darker or be relieved, or they may be general, amounting in the latter case to either *hardness* or *flatness*,—that is to say, the negative is of such nature that it will give a *hard* picture, the alternative being, according to the time of print-

[1] *A Complete Treatise on the Art of Retouching Photographic Negatives, and Clear Directions how to Finish and Colour Photographs*, by Robert Johnson. Marion and Co.

ing, chalky lights without detail or deep black shadows without detail; or is of such nature that it gives too soft or flat a print, the alternative being, according to the time of printing, shadows having no depth or lights far from pure white.

It must be understood that a negative which gives prints too hard or flat with one printing process does not of necessity do so with all processes. For example, a negative which will give a perfect print on paper sensitised on a neutral silver bath will give a soft or even flat picture in platinotype,[1] a hardish print on most brands of "preserved" albumenised paper, and a still harder one on gelatino-citro-chloride paper.[2]

It will thus be seen that it is difficult or impossible to fix a standard of density for a negative; but we may arrive somewhere near it perhaps by first giving a description of a standard silver print, as it is commonly understood, and then stating under what conditions a standard negative will give such a print.

The extremes of lights and shadows in a perfect silver print should be represented before toning and fixing by an approach to white (a slight tint), and by bronzing (a sort of metallic lustre that appears on albumenised-sensitised paper when it is printed very deeply), and after toning and fixing by pure white in the *very highest lights*—and darkness as great as the paper is giving in the deepest shadows.

A negative which will give on albumenised paper, prepared on a neutral bath of fair strength (say 50 grains), such prints, when printing is allowed to go on in the brightest diffused light, may be termed a standard negative, and any departure from it will be termed too thin or too dense.

Although the standard above described is fixed entirely with relation to albumenised paper, and although it is true that every process will give from such a negative prints differing somewhat in range of depth as well as in colour, yet I think I am correct when I say that, granted a nega-

[1] See Chapter XXXI. for description of this process.

[2] See Chapter XXI. p. 170 for description of this process.

tive with the extremes of transparency and density such as I have described, and having the gradation between such extremes good, it will be possible to get a good print from it by any process capable of giving a good print at all. I shall now suppose that the negative varies from the standard either one way or the other, and shall state how the best can be made of it, first treating of the methods whereby matters may be improved without treating the negative in any way, and afterwards describing various ways of treating the negative.

### *The Negative is too Thin*

For such a negative paper floated on a strong bath and for the full time only should be used, and printing should go on only slowly, the frames being placed where there is a subdued light. Paper prepared on a neutral bath should always be fumed when thin negatives have to be printed from on it.

Some brands of "preserved" paper give stronger contrasts than does paper prepared in the ordinary way. Such paper may be used for thin negatives.

It should be observed that a little exposure of the sensitised paper to light at any time previous to fixing does much more harm in the case of that to be used (or which has been used) for printing from thin negatives.

Now as to the negative itself. I leave out all mention of intensification, because a description of such is out of place in a book on printing; but I cannot resist describing a process of great beauty whereby the effect of a moderate amount of intensification can be produced, and which may indeed be called a process for intensifying, but is applied to the side opposite to the film. The method is an application of the powder or "dusting on" process. This process will be fully described further on,[1] here I shall just point out the principle on which it depends. Films of certain substances, which are hygroscopic (tend to absorb moisture), cease to be so after exposure to light. If such a film be

[1] See Chapter XXIV. p. 188.

partly exposed to light and partly not, so that one part is not hygroscopic whilst another is, and if any pigment in the form of a light powder be brushed over the film after it has been in a moist atmosphere for a few minutes, the powder will adhere only to those parts which have not been affected by light, and which, therefore, are not hygroscopic. If such a film be exposed under a negative and be afterwards developed with powder, a negative is the result. If under a positive, a positive.

Now if the side of a negative on glass, opposite to the film, be cleaned, be coated with the substance used in the powder process, be then placed film-side upwards in light, and be afterwards developed with powder, the result is a second negative on the front of the glass, which serves to augment the first. Moreover, the second negative is not quite sharp, and the result of this is to give a charming softness to the resulting prints. Further than this, there is great control over the results produced, inasmuch as it is possible to modify the *gradation* of additional density conferred as well as the amount. Thus only a little additional brilliancy in the high lights is required, a long exposure is given when the powder "takes" only on the high lights. On the other hand, if it be desired to bring up the half tones as well as the high lights, the exposure is made short so that the powder takes, more or less, everywhere but in the deepest shadows.

It is possible by skilfully managing the process to intensify locally with the very best results.

In the case of small negatives or even large ones where the glass is very thick, printing (through the glass) to act on the "powder" film should be done in direct sunlight, the negative being held with the plane of its surface at right angles to the rays of light. If the negative be large (say over whole plate) and the glass be not very thick, printing may be performed in diffused light. The consequent loss of definition of the "powder" image will not hurt the final result.

Of course negatives, which have been treated in the way just described, must not be printed in direct sunlight.

When the method of local modification by working on tissue paper pasted to the back of the negative is treated, it will be seen that it is also applicable to the bringing up of high lights generally, although the process is of necessity somewhat tedious.

### *The Negative is too Dense, giving Prints which are Hard*

If the negative be under-exposed as well as hard—if there be, that is to say, want of detail in the shadows—it is impossible to get a perfect print from it either by treatment of the negative or by any other method; but if the hardness be due merely to too great contrast, all the half tones being then in their correct proportion, the only defect being in fact that they range through too great a field, then it is possible by due treatment of the negative, at any rate, to get perfect prints. But first, for what can be done by treatment of the paper. In the first place, if the print be only a very little too hard when printing is performed in diffused light, probably all the improvement necessary will be brought about by printing in the brightest possible direct sunlight.

A course frequently adopted with negatives that are just a little hard is to "sun" the paper before commencing to print. The operation consists simply in exposing the paper to light till it is very slightly tinted. One corner is covered with some opaque object—a penny, for example—or the paper may be held between the finger and thumb by one corner. The object is to have one portion not acted upon by light, so as to be able to tell how far the sunning has gone by being able to compare the tint produced with whiteness. If the negative be not much too hard—only giving prints very slightly hard when the frame is exposed in full sunlight—then "sunning" may have all the desired result; but if an attempt be made to overcome great hardness by excessive sunning, the results are sure to be bad. The paper should never have more than just a visible tint on it.

Some photographers prefer to expose the back of the paper till the front is slightly tinted, claiming that they thus get a better result in this case than sunning from the front.

If the photographer sensitise his own paper, he may get better results from one dense negative than he otherwise would by floating his paper only so long as is necessary to prevent it from giving mealy prints,—that is to say, prints having a certain mottled marking in the shadows. An experiment may be made by floating for half a minute only. The paper must be quite damp before it is floated, otherwise it will not have ceased to curl before the floating is over. Paper to be used for printing from hard negatives should not be fumed.

Concerning the treatment of the negative, I may say that by far the best thing to do is to reduce it in the manner to be presently described. Strictly speaking, the reduction of the density of a negative comes no more within the scope of my present work than does the intensification; but whereas there is no perfect method of intensification known, and those imperfect ones which are known are very widely known, there is a perfect method of reduction which is by no means as well known as it should be. I, therefore, have no hesitation in giving the method which, I believe, is due to Farmer. First of all, however, let me repeat what I have already said. If the negative be lacking in shadow detail as well as being too dense in the lights, on account of under-exposure, there is no use in attempting anything. It is only when the exposure has not been too short and when the hardness is due to over-development that the process to be described is of any value.

If it has been observed immediately the negative has been fixed that it requires reduction, the process may proceed immediately. If, on the other hand, the negative has been dried, it must be soaked in water till the film is evenly wetted.

A fresh solution of hyposulphite of soda is made up. The strength does not very much matter. It may be that of the ordinary fixing bath, 5 ounces to the pint. A saturated solution of ferri-cyanide[1] of potassium (red prussiate of potash) is made up. A few drops of the latter solution are poured into the hypo solution, and the mixture is applied to the negative in a dish with constant rocking as in developing. The result will be a slight reduction of density. If it be not enough, a little more of the red prussiate of potash is poured into a measure, and the mixture is added to it, and the whole is once more flooded over the plate. When sufficient reduction has been brought about the plate is washed.

There may be an objection to risking a valuable negative by treating it in the way described lest it be destroyed—although there is little danger of this unless the operator be very careless. The writer, therefore, tried to find a process somewhat analogous to the powder process used for the intensification of negatives. The idea struck him that the "single transfer" carbon process[2] might be used in the same way as the powder process, but with the contrary effect, a reduction of contrast being brought about in place of an increase. Worked experimentally the method has succeeded admirably.

The first thing necessary is to so harden the film of the negative that there need be no fear that it will be affected by the warm water used for developing the carbon image. It is indeed advisable, although not so necessary, to harden the film when intensification by the dusting-on process is to be performed. To effect this the negative is soaked for ten minutes in a saturated solution of chrome alum, it is then washed, and the film is dried. It is a curious fact that, although chrome alum acts at once on gelatine, its full effect in rendering it hard and insoluble does not appear to take place till the gelatine has dried. The side of the plate opposite to the film has of course to be dried and thoroughly cleaned.

A piece of sensitised carbon tissue is now damped and is squeegeed to the back of the negative, just as if the plate

[1] Care must be taken not to use the yellow prussiate ferro-cyanide of potassium.

[2] See Chapter XXV. p. 197.

were a temporary support. The tissue is moved about in the water as little as possible, so as not to remove more of the bichromate than can be avoided. Pads of blotting-paper are placed both below and above the negative with tissue adhering, and a weight is laid on the top of all for quarter of an hour. The tissue has now to be dried. This must be done, of course, away from daylight; but a fair amount of heat is allowable, as there is but little chance of running. When dry, an exposure is made through the negative, and development is carried on in the usual manner.

As in the case of the powder process used for intensification, the operator has considerable power over the gradation of the negative as well as over the extremes of contrast.

Unless the negative to be treated show extraordinary contrast, the "transparency" tissue should not be used. Probably the "photographic purple" will be found the best colour for most cases.

### *Local Modifications of the Negative*

When it is required locally to modify a negative so as to increase artistic effect, the best plan is to place tissue paper at the back of it, gumming it on by the edges only, and to work on the tissue paper with crayon pencil and stump. It requires considerable artistic taste to do this effectually, but no very great manipulatory skill, as the work, being at a little distance from the film, does not print quite sharp.

It sometimes happens that a negative is faulty in that only one or two comparatively small portions of it are too dense, or even only one. In such a case the writer has proceeded with success in the following manner: —A piece of thick white blotting-paper is pasted on to the back of the negative, and with a damp finger those parts of the paper, opposite to the parts of the image, which are too dense, are gently rubbed down till, looking through the negative, with the paper next the light, it is seen that a harmonious result has been produced.

A negative so treated takes, as will readily be understood, a long time to print; but it gives excellent proofs if due care have been taken.

## CHAPTER XVI

### VARIOUS MANIPULATIONS OF CONTACT PRINTING—*Continued*

#### *Cutting the Paper*

THERE are various manipulatory operations in connection with contact printing which must necessarily be described in a book on photographic printing. It is true that most of these are not peculiar to silver printing, but are practised in connection with other kinds of printing as well, and that the description of them might perhaps be better placed after all contact printing processes have been considered than here; but I nevertheless incline to place the descriptions here, so that the work may form, leaving out the two first chapters and extending to the end of those on "various manipulations of contact printing," a complete set of instructions in the departments of printing which are commonly classed under the head of "silver printing," these being printing in chloride of silver on plain paper and printing in silver on albumenised paper. It is surely not necessary here to mention that various other processes of printing, although they are, strictly speaking, as much "silver printing" as those just mentioned, do not commonly have this title applied to them. In the case of contact printing processes, to be described hereafter, if instruction given here do not apply, the fact will be mentioned.

#### *Cutting up Paper*

The cutting up of any kind of sensitised paper, so as to leave as little waste as possible, is naturally a matter of some little importance. For some reason best known to themselves, or perhaps not known at all, the paper-makers have forced upon photographers a standard size of sheet, which is about as unmanageable as could well be conceived. This is 17 × 22 inches. Concerning the best manner of cutting up sheets of this size so as to avoid waste, I do not think that I can do better than quote Marion's *Practical Guide to Photography*, as I am not aware that the matter has elsewhere been gone more thoroughly into.

"It is desirable to have about $\frac{1}{16}$ inch margin for trimming in the case of every print, but beyond this the less there is the better. We give overleaf a set of sketches showing how paper may be cut with the best advantage for different sizes. When the sizes are small there is no great difficulty in getting a very fair degree of economy. When they are large it is far more difficult. Indeed, for some large sizes the waste is excessive, *unless smaller sizes be worked at the same time*, in which case, by getting several different sized prints from each sheet, we may have fair economy.

"We take first of all the smallest size which is likely to be required, namely, carte. The smallest divisions in Fig. 1 give sufficient for trimming on all sides, and it will be found that there are forty-two of them.

"Next we take cabinets, as this is the size next in popularity to the carte.

"Fig. 2 shows how fifteen can be cut from a sheet. A strip 4 inches wide is first cut along one end of the sheet. This is divided into three pieces. The remainder of the sheet can then be cut up into twelve more.

"$7\frac{1}{4} \times 4\frac{1}{2}$ is a popular size for landscapes. The dark lines in Fig. 1 mark out nine pieces which are a little larger than this. A strip cutting into six cartes will remain.

"Whole-plate, or $8\frac{1}{2} \times 6\frac{1}{2}$ inches, is as near as possible double-cabinet size. The thick lines in Fig. 2 mark out six whole-plate prints, leaving a strip cutting into three cabinets.

"A sheet cut into four, as in Fig. 3, gives 10 × 8 prints, with some waste, but not very much.

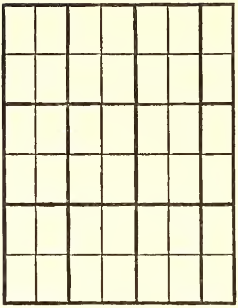


FIG 1.

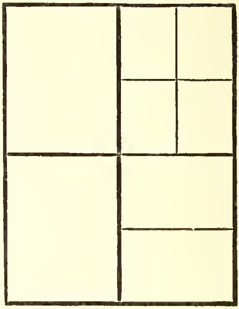


FIG 3.

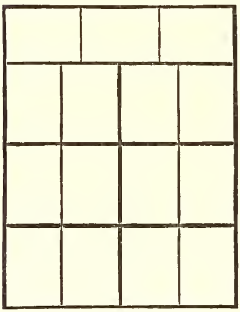


FIG 2.

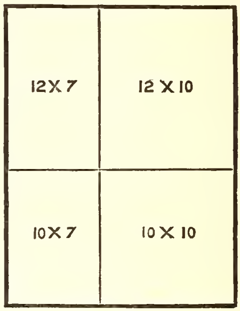



FIG 5.

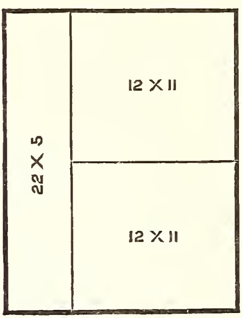



FIG 4.

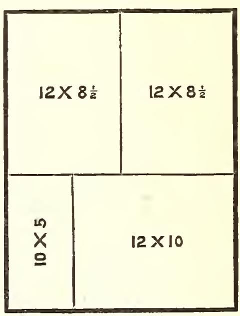



FIG 6.

"One of these 10 × 8 squares will of course cut into four 5 × 4 squares, as shown in one of the top squares of the figure; by cutting such a square in *two* as in a lower corner two $7\frac{1}{2} \times 5$ prints are got, there being in this case, however, a considerable margin of waste.

"The most troublesome size of all is the 12 × 10. In fact if no size but this be required from a sheet, the waste is excessive. In this case the manner of cutting shown in Fig. 4 is the only one to resort to.

"The size 12 × 10 is, however, too nearly square for by far the majority of subjects, and a print of that size will, as a rule, be improved by cutting away from 1 to 2 inches of the width. The same refers to 10 × 8 prints. Fig. 5 shows one good way of cutting up a sheet when both 12 × 10 and 10 × 8 prints are required. It will be seen that there is one full size 12 × 10 print got. Another is 12 inches long but only 7 inches broad. The size will be found to give a very good picture from many 12 × 10 negatives. It may be cut down to 10 × 7 and make a somewhat narrow print from a 10 × 8 negative. There is another which without any further cutting is 10 × 7, whilst there is one 10 inches square which will serve for a full-sized 10 × 8 print.

"Where 12 × 10 negatives are being printed from but no 10 × 8 ones, the method of division shown in Fig. 6 will be found very useful.

"There is one full-sized 12 × 10 print given; two of which are of the preferable size, $12 \times 8\frac{1}{2}$; and there is left a piece of paper which may be used for a $7\frac{1}{2} \times 5$ and a carte, or for a $7\frac{1}{4} \times 4\frac{1}{2}$ and a carte, or for a cabinet and two cartes."

No mention is made here of the size 15 × 12, which is one not very uncommonly worked since the introduction for general purposes of dry plates. Of this size, however, it is only necessary to say, that there will scarcely ever occur a case in which the picture will lose by cutting down the width to 11 inches, making the size 15 × 11 (15 × 10 will in most cases give a still better result), and that for this size there is no very great waste in cutting a sheet breadth-ways into two equal portions.

Various attempts have been made to persuade manufacturers to change the standard size of paper to 24 × 20, but so far as the writer is aware without success, on this side of the Atlantic, at any rate. The advantages of such a size over 17 × 22 are obvious. The sheet would cut without any waste into four 12 × 10 pieces or six 10 × 8. Seeing there is always a little loss round the margin of a negative, 8 × 6 is a very fair size to print from a whole plate negative ($8\frac{1}{2} \times 6\frac{1}{2}$), and of these twelve could be cut from the sheet. Twenty cabinets could be cut with scarcely any loss by dividing the length into four parts and the breadth into five. Forty-eight cartes-de-visite could be got with but little waste by dividing the length into six, and the breadth into eight.

There appears, however, but little chance of our at all speedily getting a sheet of albumenised paper 24 × 22 ; but this size has latterly been adopted by the Platinotype Company, whose productions will be referred to in connection with platinotype printing.

In cutting up sensitised or albumenised paper care should be taken to finger the surface as little as possible. This is indeed a remark that applies to the process at all stages.

# CHAPTER XVII

## VARIOUS MANIPULATIONS OF CONTACT PRINTING—*Continued*

### *Vignetting*

THE vignetting of prints is not very difficult, and is an operation which for a certain class of effects gives very pleasing results.

The art of vignetting dates from 1853, the name of the inventor, Latimer Clarke, at any rate if the testimony of the note written on a print which Mr. Lionel Clark has shown me is to be relied on. The note states that the print was produced in the year mentioned, and that it is undoubtedly the first vignetted photograph produced. As such it is interesting, but it would certainly in the present day be considered a very poor specimen of the printer's art. The shading off—which indeed scarcely deserves the name of shading—is abrupt and irregular in form.

When first vignetting became at all fashionable, and when the effect of shading off to pure white at the edges of the print was very much admired, a great mystery was made of the manner of production, and the secret was sold for large sums. It would have astonished the photographers in those days not in the secret—and perhaps some of those in it—if they had been told that in the future perfect vignettes would be produced by the simple and apparently crude expedient of printing through a hole in a piece of brown paper; yet such is the case. The various appliances in this way of vignetting glasses, etc., which were once exceedingly popular, are going greatly out of fashion. Not because they are not useful in certain cases. They are. But because with care and skill as good results can be got by the use of a hole in any flat, thin, opaque substance as by any vignetting glass or such appliance; whilst to produce really good all-round work, it is necessary to make each negative a study, and to modify the shape of the vignetting aperture according to the nature of the picture—a thing scarcely possible where vignetting glasses, etc., are used.

Vignetting glasses, it should be explained, are plates of glass which have a non-actinic "flushing"—generally of a ruby colour—over the whole of the surface except an oval or pear shaped part of the centre. This part is clear—the flushing having been dissolved away by hydrofluoric acid—and there is a shading off between the clear part and the rest of the plate.

Such glasses are very handy when it happens that one is at hand, the opening of which is of precisely the right size and shape, and this is the case sometimes, especially in landscape work, where it is desirable to have a perfectly oval-shaped—or, more strictly speaking, elliptical—picture.

Before giving details of the manipulations in connection with vignetting, a word or two should be said as to the character of picture that will stand the treatment; for it must be understood that by no means every negative, even of such that will give good pictures, will give an artistic vignette. It is a very common error with beginners to vignette every picture indiscriminately. They find that to vignette—in the sense of producing a shading off of the picture—is so easy that they are charmed with the process and apply it to every negative they have. Now I think it is not too much to say that only about one out of four or five negatives is suitable for making a vignette from, and that when it is, the utmost care and discrimination are necessary in either selecting a suitable board or glass, or in making and using one.

I have not sufficient artistic knowledge to be able to say with confidence that I have analysed the qualities of the negatives that will give a good vignette and of those that will not; but so far as I can judge the following is correct:—A picture distinguished by softness and delicacy, and in which there is much small detail of a "sketchy" nature, if I may use the word, is suitable for vignetting. Often a negative all but spoiled by over-exposure gives an excellent vignette; whilst one in which there are strong and bold contrasts and effects of light and shade—especially if the shadows somewhat predominate—is unsuitable. One thing that appears to entirely disqualify a picture for vignetting is a large mass of shadow reaching the border of the vignette, which, were the picture not vignetted, would extend into the place occupied by the white margin in the vignette.

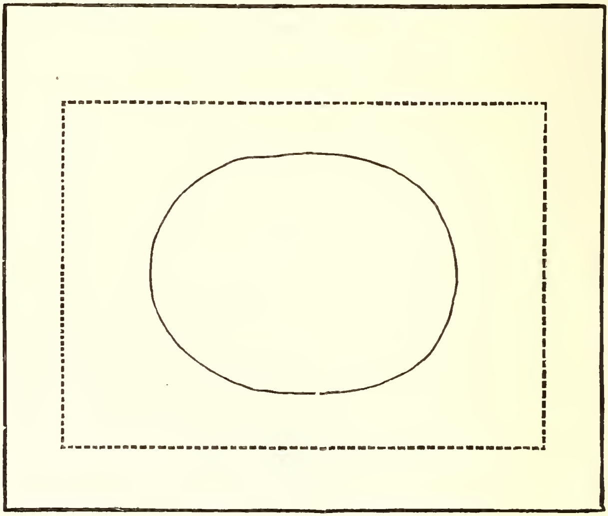
Whatever general rules may be laid down, however, this is to be said. He who is possessed of artistic taste will know instinctively what to vignette and what not, better than one without such taste will know by studying any number of rules. A similar remark would apply to very many photographic operations.

And now for the actual manipulations. I shall suppose in the first place a very simple case—namely, that in which a perfectly elliptical picture is required from the central part of a soft landscape negative,—that is to say, where it is not necessary or even desirable to suppress a little more of one side than of the other side of the negative, a little more of the top than the bottom, or of the bottom than the top.

A vignetting glass, with an elliptical clear space somewhat *smaller* than the required image, is taken, and is fixed in any way at a distance of about quarter of an inch in front of the negative. In the case of the common form of cheap frame it may simply be laid in front of the frame; but the mistake must be avoided of supposing that the gradation of the tinted glass is sufficient, and of consequently placing the glass directly in front of—in contact with, that is—the negative. It appears to be impossible to so finely shade off glass that the mere printing of the shading gives a good vignette. It is necessary to give some additional shading by the diffusion of light.

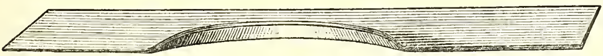
The frame with vignette glass is printed in diffused light, in shade, that is to say, every operation of printing being conducted in the usual manner. The effect will probably be somewhat improved by fixing a piece of tissue paper in front of the glass. This remark applies whether a vignetting glass or any other arrangement be used.

A piece of opaque paper of any kind with an oval opening in it will work very nearly as well as a vignetting



glass. It is simply fixed in any way across the front of the frame. It may be gummed on if it be flexible enough, and may be fixed with drawing-pins if it be stiff. Even common brown paper will do, and is indeed very commonly used; but something stiff, such as millboard, is far more handy to work with. If the gradation be required to be somewhat abrupt, the opening is simply roughly cut, as shown in the diagram.

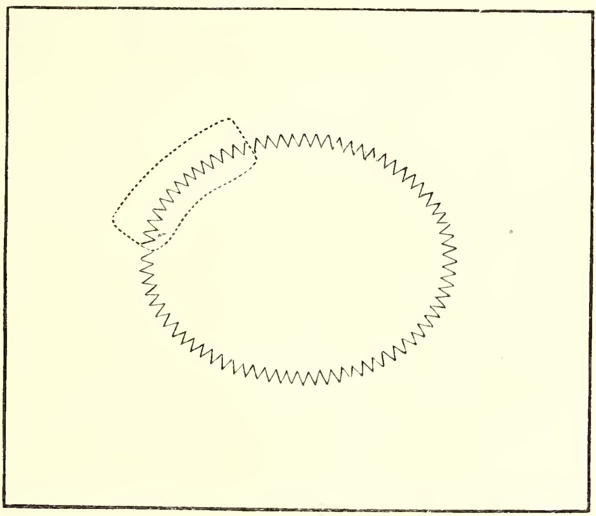
If it be desired to make the gradation more soft, the vignetting board may be placed somewhat further from the negative. This, however, involves the use of a small wooden frame, or some such arrangement, to keep the vignetting board away from the printing-frame. A plan that has the same effect, using millboard, is to bend up the edge of the oval with the finger and thumb so as to raise it further from the glass. An attempt has been made to illus-



trate the manner of doing this in the accompanying cut, which is supposed to represent such a vignetting board cut in half.

A third, and a very excellent method, is to serrate the edge of the oval as shown here. The serrations may be made deeper the more gradation is required.

Yet another way of bringing about the desired object—a very soft gradation—is to cut the hole in the opaque



mask somewhat larger than it would be cut were no special means of softening to be adopted, and to gum on to the face of it several sheets of tissue paper, cutting through each an aperture concentric with the larger aperture,—if we may be allowed to use the term for a figure which is not a circle,—but a little smaller either than the opening in the opaque screen or in the sheet of tissue paper which has been gummed on just before it. In some vignetters, made commercially, this plan is followed out, and the edge of the opening in each sheet of tissue paper is serrated. This appears to be almost an unnecessary refinement, but certainly, if such vignetters happen to be of just the right size and shape, excellent results are obtained.

In the early days of vignetting use was made of cotton-wool to a considerable extent, the wool being gummed or otherwise fixed to the inside of the opening in the opaque screen. So far as the writer knows this plan is but little used now, but he has found cotton-wool useful at times to check the tendency that there is, when the attempt is made to vignette certain subjects, for some part of the image to spread beyond the general outline of the vignette. When this tendency shows itself and cannot readily be checked, by fixing a little bit of paper to the inside of the opening—as will be presently explained—a little cotton-wool may be pushed lightly in between the edge of the opening of the vignette and that part of the negative which tends to print beyond the proper boundary.

So far we have only considered the case of a vignette which is elliptical in outline; but it happens very frequently —almost always in the case of portraits—that a perfect ellipse is not the best shape of vignette. Of course this is a matter in which the taste of the operator will show itself very greatly; but it may be said that the outline of the opening of a vignetter suitable for a portrait is very often something approaching a pear-shape, the wide end of the opening being downwards. The outline must, however, somewhat follow the outline of the figure.

I again borrow a cut from *Marion's Practical Guide to Photography* to illustrate the matter. In this a dotted line shows approximately the shape of opening that would be required to vignette a certain figure.

Whilst on the subject of the vignetting of portraits, I should say that the general characteristics of a portrait negative to be vignetted should be the same as those of a landscape negative—softness and delicacy—and that besides special attention should be paid to the background. The commonest background to use for a vignette is one which prints off a uniform light tint (not quite white, however);

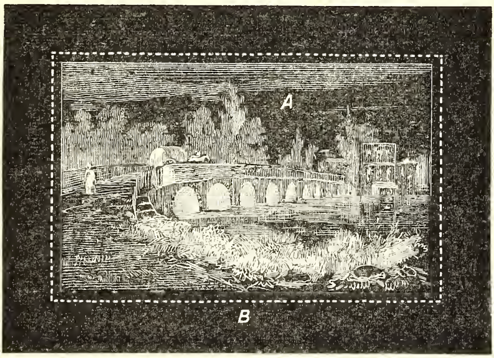
but it is by no means necessary that it be uniform. Any background which is the reverse of conspicuous, which has no tint deeper than a half tone, does well for a vignette. The thing to be particularly avoided is a dark background, or one of a pronounced type. A blanket placed so far behind the sitter as to be quite out of focus, generally makes an excellent background for vignettes.

Even if the best of skill be exercised it is seldom, except when the conditions are very simple, that a suitable vignetter can either be selected or made so as to give results altogether satisfactory without a little "dodging." Generally the first proof will show that either a little too much of the subject is cut off at some place, or that it extends too far somewhere, or both defects are exhibited. If the subject is too much cut off anywhere, all that is necessary is to turn up the edge of the vignetter a little over the particular place, or to tear a little of it right away. If the subject incline at any point to extend too far, a piece of paper may be gummed on to the edge of the aperture, filling in a part of the latter; or if this plan is not efficacious, a little cotton-wool may be inserted between the edge of the opening of the vignetter and the negative as already described.

It is always a good thing in vignetting to print through tissue paper, but it is specially so when the subject is a difficult one.

In the case of a difficult subject it is sometimes necessary to take several proofs, and to modify the vignetter after each before a perfect result is got. It need scarcely be said that any spoiled pieces of paper—so long as visible prints can be got on them—are good enough to make trials with, and that when a vignetter well suited to a particular negative is got after several trials, it is a thing not to be thrown away till the operator is sure that he has got all the proofs off that negative.

It is sometimes desirable to print the image right up to the edge of the plate in vignetting, and to allow the white margin to extend beyond the limits of the negative. For example, it may be desired not to lose any of the picture at either end of a $12 \times 10$ plate. In this case a good result will be got by printing the image on to the centre of a piece of paper $14 \times 10$ inches, or even a little larger, allowing the outside of the shading (or the commencement of the pure white) to be just over the two ends of the negative. If an attempt be made to produce such a vignette in the ordinary way, with no special precaution beyond placing the negative in an extra large printing-frame, it will be found impossible to avoid printing the edges of the negative, which will show as dark lines beyond the image—in what ought to be the pure whites of the margin. By the following very simple arrangement the writer has been able to get over the difficulty:—A piece of nonactinic paper is taken. The outside is cut to the size of the print that is required or larger. From the centre is cut a piece about quarter inch smaller each way than the negative. For example, if the negative be $12 \times 10$, the opening in the mask is cut to about $11\frac{3}{4} \times 9\frac{3}{4}$. This leaves a margin of about one-eighth inch for fixing the mask to the negative. The mask must be fixed with strong glue to the *film* side of the negative. The negative is then laid against the plate glass of a frame at least as large as the outside of the print required. The mask may be used to temporarily fix the negative to the plate glass by gumming the paper to the latter. The printing of vignettes may then go on in the usual way, the shading being if desired carried right up to the edge of the mask. The following cut shows the negative and the mask:—




A is, of course, the negative, B the mask. The dotted line shows the edge of the negative; the inner full line the inner edge of the mask.

### *Reversed Vignettes*

The reversed vignette, or vignette with a dark border, was at one time very much admired, and is still sometimes to be seen. It wants very considerable skill to produce such a vignette, unless the negative be specially prepared for it. The objection to so preparing the negative is that it requires a special arrangement in the camera, and that a negative, when so specially prepared, is not suitable for any purpose except the production of reversed vignettes.

The manner of operating in the camera is as follows: An arrangement is made so that vignetters, consisting simply of pieces of stiff cardboard or board with openings in them, can be placed in the camera between the lens and the ground glass, and so that the distance between the lens and the vignetter can be so adjusted as to give the requisite softness to the edge of the shadow of the latter on the ground glass, the softness being greater the nearer the vignetter is to the lens and the larger the stop. The background should be dark. The camera is then so adjusted that the image of the figure on the ground glass falls into the proper position relative to the shadow of the vignetter.

It will be quite evident that where the shadow of the vignetter protects the edges of the plate, causing them to be transparent after development, the margins of the paper will print black.

The method of printing reversed vignettes from ordinary negatives is as follows:

An ordinary vignette is first produced in the manner already described. The print so got (of course before toning and fixing) is placed behind a plate of clear glass in an ordinary printing-frame. A piece of stiff cardboard of the size and shape of the image of the vignette (that is to say elliptical, or of a shape something approaching this) is cut out, and is fixed at a little distance over the image so as to protect it, whilst the margins of the print are left unprotected. The fixing is done by gluing a piece of cork to the plate of glass over the centre of the image, and gluing the piece of cardboard to the cork. The height of the cork must be greater the softer is the vignette. When the arrangement described has been made, the frame is placed in diffused light till the margin has printed quite black, when the proof is ready for toning.

Some prefer not to vignette at all to begin with; but to produce the reversed vignette direct upon an ordinary print, exposing till the image at the margins are completely obliterated, and indeed a little longer, otherwise the details in the dark margin will be liable to reappear to a slight degree during toning and fixing, producing a very unpleasant effect.

*Vignettes with tinted Margins*

In some cases it is preferable to have the margins of a vignette tinted rather than pure white. This tinting is effected in the first of the two ways already described for producing a reversed vignette from an ordinary negative, but that the exposure of the margin is only carried on for a few minutes till a slight tint is acquired in place of till the margin is black.

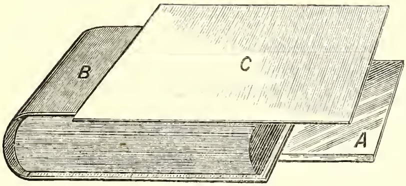
## CHAPTER XVIII

### VARIOUS MANIPULATIONS OF CONTACT PRINTING—*Continued*

*Skies—Composition Printing*

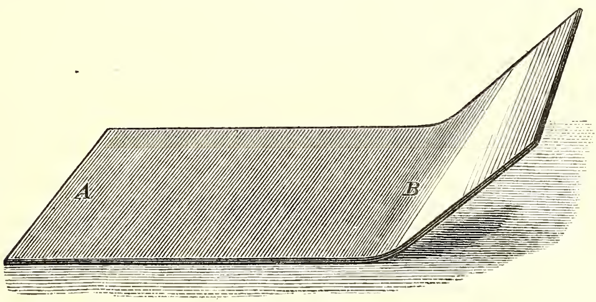
No landscape having any artistic pretensions whatever can be allowed to have a perfectly white sky, or indeed, except in very few cases, can it be allowed to have a sky of one uniform tint. The production of a sky generally requires a separate printing, because landscape negatives scarcely ever show any trace of a sky. It is true that with the new orthochromatic plates this defect may perhaps be remedied to a very considerable extent, but probably it will always be at least a common practice to put in a sky artificially, or print it from another negative.

The last-mentioned manner of producing skies is the commonest and moreover the best. It constitutes the simplest form of composition printing. I shall, however, first describe some other methods which are sometimes made use of for producing skies. The first is for producing a graduated sky merely. It may be applied when the sky prints quite or nearly quite white. In a very few instances it produces a really good effect; but the best that can be said for it in most cases is that it gives a result somewhat better than a plain white or evenly tinted sky. It is produced simply by exposing the print to the light with the lower or landscape portion covered, and with some arrangement whereby a gradation of tint is produced, getting darker towards the top. This may very well be done by laying the print under a sheet of clean glass, placing a thick book or other similar object over it, so as to shade the landscape portion, and then a sheet of cardboard or some such object over the book projecting




beyond the edge of it over a portion of the sky. The cut will explain the arrangement. A is the sheet of glass with the print under it; B is the book, or similar object; and C is the piece of cardboard. Of course printing must be performed in diffused light. Care must be taken to allow C to project so far beyond the book that the front edge of the latter will not cause an abrupt mark on the print.

Some operators prefer to use a piece of bent sheet-metal, as shown on the accompanying cut, laying the por-




tion A directly on the sheet of glass; but the writer prefers the arrangement just described, as it gives greater latitude of result.

With a sky that prints a uniform tint, clouds may be put in by hand on the back of the negative, if the operator have skill enough. He may do this either by colouring direct on the negative or by stretching a sheet of tissue paper over it as already described in Chapter XV. page 118, the clouds being produced on this paper with charcoal and a stump. To produce an effect at all good and natural requires considerable artistic knowledge and skill, but once a sky is put in as described, there is the great advantage that printing may be proceeded with at once, no second operation being required to produce the clouds.

If a sky prints with a tint, and it be determined to print clouds into the proofs from it by the aid of a separate cloud negative, it is necessary—unless the tint be *very* slight—to block out the sky. This may be done with Bates's black varnish and a small camel's-hair pencil. A steady hand is required, but there need be no great difficulty in performing the operation, as any varnish which has gone over the line between sky and landscape can be taken out by rubbing with a rag dipped in a little benzine. Care must be taken not to allow the varnish to run into a thick ridge next to the outline of the objects, otherwise there will be blurring of the print from want of contact between the paper and the negative. When the outline is carefully painted in, the rest of the sky may be quickly blocked out with a larger brush.

Prints with white skies being once produced, it is necessary to select suitable cloud negatives for printing into these skies. I cannot here enter into the question of the production of such negatives. I can only say that, in the selection of particular clouds for a certain landscape, the photographer must be guided, as in so many other cases, by his artistic taste. Of course he will avoid such outrages as the use of clouds lighted from one side with a landscape lighted from the other, or of clouds taken near the sun with a landscape lighted from nearly in front, or from one side.

If the skyline be nearly straight the same method may be used in printing in clouds as in producing a graduated sky,—that is to say, the print is placed behind a sky negative, being so adjusted that the clouds fall into suitable places, so as to "compose" with the rest of the picture.

The two are placed in a printing-frame, which must be of considerably larger size than either the print or the negative, so as to allow of the free adjustment of the former with regard to the latter, without danger of having the paper folded at the edge of the frame, and the picture part of the print is shaded with a book or such like object, and a piece of cardboard. This method is only possible when the horizon line is nearly straight, or when only black or nearly black objects extend into the sky. It is the practice of some photographers to print clouds right across even comparatively light objects, such as a church spire, printing in the clouds only very faintly; but the practice is one by no means to be recommended.

With subjects where what I may call the "graduating method" would have the result that the clouds would be printed over parts of the subject which are comparatively light in shade, the best way of working is to begin by making a "mask" to protect the landscape. The easiest way of doing this is to make a print—which may be on any piece of spoiled sensitive paper, and to cut very carefully round the line between the sky and the landscape. The landscape portion of the print, untoned and unfixed, is then attached to the sky negative, albumenised side next the film. The fixing may be done by a drop of gum at each of the lower corners of the print, so adjusting the position of the negative and the mask that the clouds left uncovered are suitable for printing into the proofs. In cutting the mask care should be taken that, if an error be made at all, it be made in cutting away a little of the landscape rather than in leaving any of the sky, and this for the reason that, if the sky a little overlap the landscape, the overlapping is scarcely noticeable, whilst, if even the thinnest line perfectly white intervene between the landscape and the sky the effect is conspicuous, and is conspicuously bad.

In adjusting the print against the masked negative, the same precautions must be observed. The sky must be made to overlap (a little) the landscape, rather than leave a space between the landscape and the sky.

It will be readily seen that when a print has been arranged behind the sky negative, it may at once be put out to print in any light, and without any further shading. There need be no fear that the clouds will print through the mask, as the whites of this latter quickly blacken by the light, till the paper is quite opaque. But although no shading is necessary, it is generally advisable to shade to a certain extent, so that the sky may print somewhat more lightly at the horizon than at the zenith, and this for the reason that the sky—in this country at any rate—generally appears brighter or whiter near the horizon than nearly overhead.

Where the special printing-frames made to facilitate compound printing is described a little further on, it will be at once seen that where it is desired to print skies into a number of similar prints which require the landscape to be marked out such frames will save much trouble, as the most difficult part of the process, without a special frame, consists in adjusting, with precision, the print behind the mask, or perhaps rather in preventing it from shifting its position whilst the back is being applied to the frame.

### *Composition Printing*

Composition printing consists in producing a print, different parts of which are printed from different negatives, of which there may be two—as in the very simple case of the printing of skies into landscapes—or many, a dozen for example, in cases of very complicated figure subjects.

The object of composition printing is to make photographic pictures which, on account of the limitation of the powers of the lens, etc., cannot be produced at one time. I have read that the great master of photography as an art, O. G. Rejlander, who was the first, or one of the first, to use composition printing successfully, was first lead to make use of more than one negative to produce a photographic picture when, on attempting to carry out an idea he had of a group which involved figures both behind and in front of a sofa, he found it impossible to get both into focus at one time.

Rejlander worked in the days of wet plates, when exposures were comparatively very slow unless large apertures of lenses were used. At the present time such a difficulty as that described would be got over by *forcing* the figures into focus, by using a small stop, which is possible with the very rapid modern plates. And the possibility of using small stops is a reason why composition photography is practised less than it once was. It has other uses, however, than merely getting over the difficulty of focus. For example, it permits of figures being taken in the studio where there is a possibility of modifying the lighting, and of being printed into landscapes. It also enables figures, taken in the studio, to be printed into interiors where the exposure, even with modern plates, would put portraiture quite out of the question. In fact, it has many uses; but the writer's object is rather to describe the mere manipulations which have to be gone through rather than to discuss the subject generally, or from the artistic point of view. He advises those who wish to study the latter side of the subject to take up Abney and Robinson's book on silver printing,[1] where it is treated very fully.

I shall suppose first of all the simple case where it is desired to print a single figure into a landscape. A print is taken of the figure on a piece of sensitised paper. With a very sharp pen-knife the figure is cut out, keeping very closely to the outline. The result is two masks: one of the figure, which may be attached to that part of the *landscape* subject which it is desired the figure should occupy, the other mask of all but the figure. This latter is used to cover up all the figure negative except the figure only. It is thus only necessary to print the figure first and to adjust the figure print carefully behind the landscape negative, when a composition is produced. It will be at once evident that a group of figures, which in the photograph run into each other, can be treated in the same way, or a number of

[1] *The Art and Practice of Silver Printing*, by P. Robinson and Captain Abney, R.E., F.R.S.

figures each on a separate negative, the figure negatives being masked out all but the figure, in the way that I have described—or by the use of black varnish as described for skies, if it be preferred—and the places in the landscape to be occupied by the figure being protected by the cut out prints of the figure.

Let us now go one step further and suppose that it is desired to print a sky into the already composite subject. All that is necessary is to block out the sky of the landscape negative, and to sacrifice one composition print of landscape and figure or figures for the production of a mask for the sky negative selected. It is assumed that the upper part of the figure intercepts the horizon line of the landscape. The cutting of the mask is along the horizon line and round that part of the subject which projects above it. The mask is attached to the sky landscape as already described, and the sky is printed in just as though there were a landscape without figures.

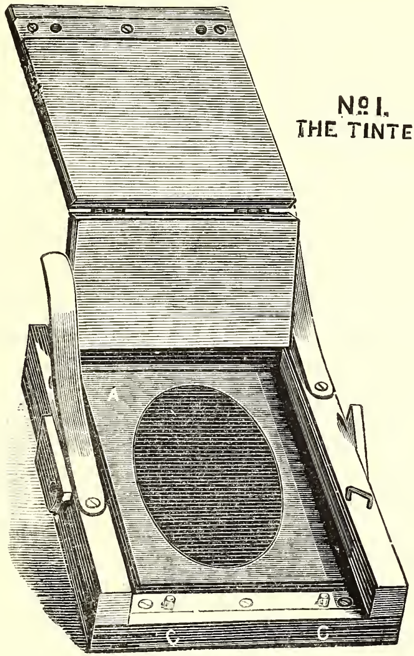
There are very many other "dodges" in connection with composition printing, but it is very difficult to explain them without an illustration showing the effects. In the book of Robinson and Abney, mentioned above, there is an excellent example of a composite print from six negatives. The subject is a particularly difficult one, and the description of the method of printing, accompanied by a photographic copy of the actual result, is most interesting.

The only manipulatory difficulty that is likely to be met with in composite or combination printing is in accurately adjusting the print behind the second (and perhaps third, fourth, etc.) negative. I therefore describe a special frame which serves the double purpose of assisting in the adjustment of the masks, and in making the adjustment of the print under the various negatives a matter requiring no skill at all.

I here give a drawing of the frame.

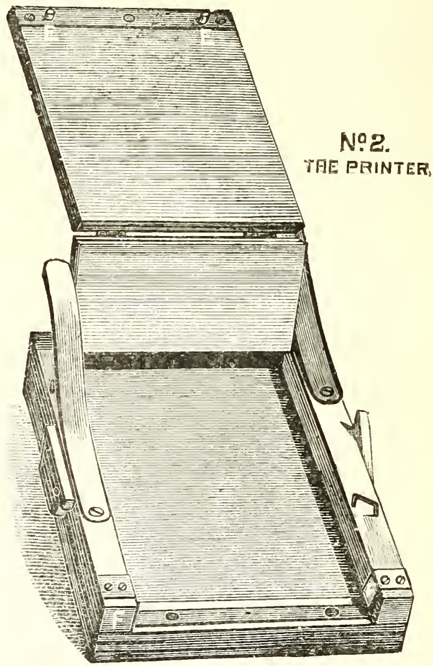
It will be seen that the frame does not greatly differ from an ordinary one except inasmuch as there are, at one end, and beyond the negative, two punches marked *c*, *c*.

I shall now describe the method of using the frame—or frames rather, for one is needed for each negative used in printing a composite—and premising the description by saying that the frames must be all of the same size and somewhat larger than the largest negative that has to be used for the composite, and that, for the convenience in




working which the frames bring about, it is necessary to pay in some waste of sensitive paper.

I take again the very simple case in which it is desired to print a figure into a landscape. The figure landscape is fixed in the centre of one of the frames by the aid of strips of paper and glue. A piece of sensitised paper of the whole size of the back of the frame is now placed in position, and the back being brought down, two holes are punched in one end of the piece of paper. After printing, the figure is carefully cut out, as already described. A second frame is now taken, and the landscape negative is placed in it. The mask representing everything except the figure is now placed on this frame with the albumenised side next the film of the negative, the punches of the second




frame being made to pass through the two holes made in the mask by the punches of the first. The negative is adjusted under the mask till that part of it (the negative), which represents the space that is to be occupied by the figure, is under the opening in the mask.

The mask is now removed, and the negative is fixed down to the plate glass of the frame by strips of paper or otherwise. The mask is readjusted over the landscape negative, *the mask representing the figure* is adjusted over the landscape negative by the aid of the mask *representing all but the figure*, by making it fall into the place from which it was cut, and is gummed down to the surface of the negative.

Printing may now proceed quite mechanically. Paper is cut to such a size that it will, when placed in the frames, project over the punches. The mask representing all but the figure is placed on the figure negative by the aid of the punches. A piece of fresh paper is placed over it and the figure is printed. The print of the figure is then placed in frame No. 2, making the punches of this frame pass through the holes of the paper produced by the punches of frame No. 1, and the landscape may be at once printed in. It will be evident that this principle may be extended to any number of negatives, a self-registering frame being used for each.[1]

[1] The frame just described is known as "Hemery's Patent Automatic Self-Registering Printing-Frame." There would appear to be something tautological in this high-sounding title; but any way the frame is an ingenious and useful article.

## CHAPTER XIX

### SILVER PRINTING

*Gelatino-Bromide of Silver for Printing—Direct Enlarging*

PRINTING on gelatino-bromide of silver has of late years become very popular. The process consists of impressing, with a very short exposure to light, an image on a paper-supported film of gelatino-bromide emulsion, and afterwards developing, generally with weak ferrous oxalate.

The process was, I believe, patented by Swan nearly ten years ago. Certainly the first prints on gelatino-bromide I ever saw were in Swan's hands some eight years ago; but since then the process has been thrown open to the public, and gelatino-bromide paper is now sold by most dealers. The emulsion used is generally considerably slower than that with which plates are coated, the necessity for perfectly pure lights involving this.

There are various advantages in the process. The colour in the first place is an engraving black. This is not admired by all; but by those who have artistic knowledge it appears to be generally preferred to the brighter colours of the process, commonly entitled "silver printing,"—that is to say, printing on albumenised paper. To the writer it appears that, although the colour (and he may add the surface) is not very well suited to very small work, it is suited to all other, and particularly to very large work.

The precise degree of permanency offered by bromide prints is a matter at present under discussion, and therefore I say nothing of the matter further than to state that prints by this process are almost certainly of a much more stable nature than those on albumenised paper, and that it is quite likely they are "permanent" in the sense that they will, if properly prepared, last as long as the paper which supports them.

The great advantage of the process undoubtedly is, however, the shortness of exposure required. So brief is this that, in the case of contact printing, it is not usually advisable to print by daylight at all, as the exposure required would be so short as to be quite beyond control. The exposure at two or three feet from a gas-burner will vary from a second or two to a minute, according to the density of the negative and the rapidity of the paper, the paper of different makers varying a good deal in sensitiveness.

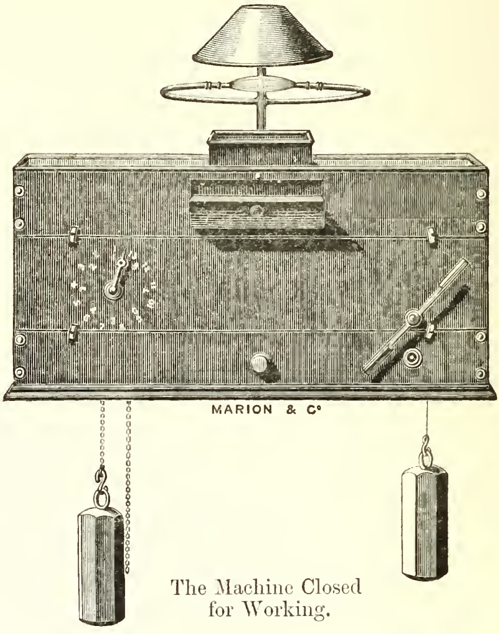
The great sensitiveness of gelatino-bromide paper as compared with other kinds of paper for positive printing renders it particularly well suited to direct enlarging, which shall be briefly described. Contact printing calling, however, first for attention.

### *Contact Printing with Gelatino-Bromide Paper*

The printing may be performed in the usual manner in the ordinary printing-frames, the paper being, of course, manipulated only in the dark room, and exposure being made at, say, three feet from an ordinary burner. As there is no visible image, it is necessary to determine the exposure by one or two trials. After this printing can go on for any length of time, as the light from an ordinary gas-burner varies so little that there need be no fear of irregularity in the results if the same exposure be given over and over again.

A very ingenious machine has been invented by Urie of Glasgow for printing a number of impressions from a single negative. The paper in this case is used in a continuous band, which is brought under the negative, being moved on the length of the print after each exposure. The light is supplied by a gas-burner over the negative, a flat dish of water intervening to prevent any heating of the plate. The light is automatically lowered for an instant as the band travels.

The exposure is determined by trial and error at first; the machine is then regulated to give the same exposure over and over again, and may be left to its own sweet will. I here illustrate the appliance.

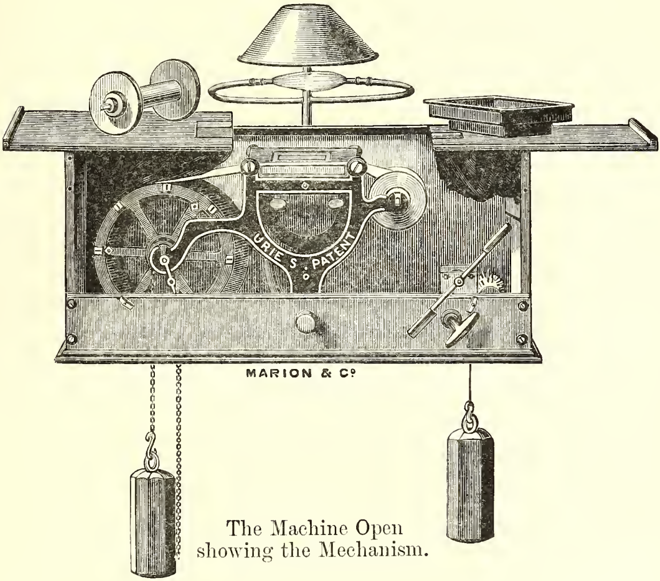



The Machine Closed for Working.

*Development*

It will be found that each maker of paper issues a formula for development, and it is well—as in the case of plates—to adhere to this formula, although it appears to be by no means necessary.

What is necessary is that the developer be not very strong, and that it be distinctly acid. In fact, the writer has found an improvement in results to arise from the use of what might at first sight appear to be an enormous quantity of acid. Thus he has found that 3 per cent of citric acid or 1 per cent of sulphuric acid added to the mixed developer had no great retarding effect on the development, whilst it ensured lights of a pearly whiteness. This is, however, an amount which it is perhaps rash to use. About half of this quantity may, however, be made use of without any hesitation.




The Machine Open
showing the Mechanism.

The following developer may be taken as one which will give good results with almost any brand of paper :—

| | |
|---|---|
| Saturated solution of ferrous sulphate . | 1 ounce |
| Saturated solution of oxalate of potash . | 4 ounces |
| Water . . . . . . | 5 „ |
| Citric acid . . . . | 40 grains |

The paper (exposed) is first soaked in water, great care being taken to remove any air bubbles which may adhere to the surface. It is then placed (film side upwards) on the bottom of a white dish, and the developer is poured over it. The image will quickly appear and must be closely watched, for it must be borne in mind that there is no reduction of depth in the fixing bath. The print deep enough, is at once removed to a 2 per cent mixture of sulphuric acid and water. It may remain here till others are developed if there are a number.

When the negative is thin and full of detail—a particularly suitable negative for most brands of paper—the exposure must be short and the development must be comparatively protracted, occupying perhaps five to eight minutes. If, on the other hand, the negative be of full density, the exposure is prolonged to such an extent that, with a development such as that given to the print from the thin negative, the whole image would be enveloped in fog. In fact, the exposure must be increased more than in proportion to the density of the negative. The prints from the dense negative require but a short development. Very often not more than half a minute, and it is necessary to watch very closely to prevent the process from going too far, the result in such a case being a clogging of the shadows, and also, very likely, a degradation of the whites.

If it be desired to get a good print from a very thin negative some restrainer may be added to the developer, but normally this is not required.

It will be perceived that by varying the exposure and adjusting the developer to suit it, there is a great power of getting prints, having similar characteristics, from negatives varying very much in the matter of density; but it must be understood—as indeed may be understood of any printing process—that from an under-exposed negative no good result can be expected.

The prints developed should be passed through three baths of weak sulphuric acid to remove the last trace of iron from the paper.

### *Fixing the Prints*

After the developed prints have gone through the three acid baths, they are but slightly sensitive to light, and may be further manipulated with almost as much freedom as prints on albumenised paper,—that is to say, they may be freely exposed to gaslight, or even to very dull daylight.

The acid must be got rid of before fixing, otherwise the permanence of the print will be endangered just as already explained in the case of a print on albumenised paper. The washing necessary to remove the last trace of acid is very great; and it is therefore advisable, after washing for a few minutes, so as to get rid of the greater part of the acid, to place the prints for a few minutes in a weak solution of washing soda. They are then placed in an ordinary fixing bath, such as is used for negatives, but it must be freshly mixed, and should be used only once. It may be retained afterwards for fixing negatives. The prints must be kept moving in the fixing bath. It is not very difficult to see when fixing is complete. Only a minute or two are required, but it is well to have the prints in the fixing bath from ten minutes to quarter of an hour. When fixed, they are washed just as carefully as are prints on albumenised paper.

### *Pyro-Developer for Bromide Paper*

Very good results can be got on bromide paper by the use of almost any pyrogallic acid developer which is weak, contains a considerable quantity of restrainer, and a large quantity of sulphite of soda. The colour got—although it can only be called a black, like that got by the iron developer—is slightly different, and is preferred by some.

Ammonia may be used as the alkali, but as a rule better results will be got by the use of carbonate of potash or of soda. The following carbonate of potash developer will be found to give good results :—

*Stock Solution*

| | | | |
|---|---|---|---|
| A | Pyro | | 1 ounce |
| | Sulphite of soda | | 3 ounces |
| | Citric acid | | $\frac{1}{4}$ ounce |
| | Bromide of ammonium | | $\frac{1}{4}$ ,, |
| | Water | up to | 10 ounces |

Dissolve, with heat, the sulphite of soda in 6 ounces of water, add the citric acid and the bromide of ammonium, pour the liquid over the pyro, and make the quantity up to 10 ounces.

| | | | |
|---|---|---|---|
| B | Carbonate of potash | | 1 ounce |
| | Sulphite of soda | | 1 ,, |
| | Water | up to | 10 ounces |

To develop, take for each ounce of developer required 15 minims of A and 40 of B, and make up with water. The development will be slower than with iron.

*Warm Tones with Gelatino-Bromide Paper*

So far as I am aware, A. Cowan was the first to show that there is, at any rate in the case of some samples of bromide paper, a very appreciable range in the tone obtainable, an approach to a sepia tint being got by exposing many times as long as is necessary to obtain a black tone, and by using a very much restrained developer. Those who wish to experiment in this direction may try the result of giving an exposure twenty to forty times longer than is necessary for a black tone, and of adding 6 to 8 grains of bromide of ammonium to each ounce of the developer.

*Vignetting Gelatino-Bromide Prints*

Gelatino-bromide is particularly well suited to the production of vignettes. The vignetting is done in precisely the same way as if the paper to be used were sensitised-albumenised paper, a piece of tissue paper being however *always* used in front of the vignetter. If the negative be at all a difficult one to vignette, it will be found an advantage to use albumenised paper for the test prints in making the vignette.[1] This remark applies to the production of vignettes for any printing process which does not permit of an examination of the image during progress in the printing-frame.

### *Direct Enlargement on Gelatino-Bromide Paper*

As has already been mentioned, gelatino-bromide paper is particularly well adapted to direct enlargement. In fact, before its invention, direct enlargement was a thing scarcely practised except by large firms, who could afford to erect the ponderous arrangement known as a direct solar-enlarging camera, or by those who cared to go in for the somewhat difficult process of collodion transfers. Indeed, the practice of direct enlargement was a thing beyond the scope of amateur photographers, and even of the bulk of professional photographers; but the advent of gelatino-bromide has changed all this, and to enlarge is now almost as easy as to make a contact print.

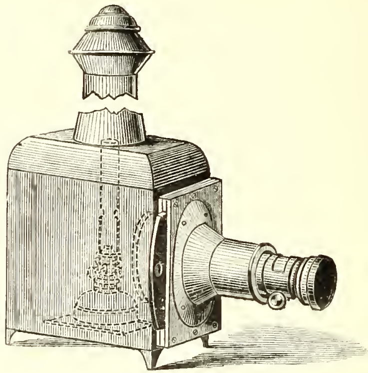
I ought to explain that *direct* enlargement means enlargement without the necessity of first producing an enlarged negative as in many enlarging processes.

Most readers of course understand the principle of direct enlargement; but those who do not will readily conceive it by considering the action of the optical or "magic" lantern. In this a small transparency, placed behind an objective, produces a greatly enlarged image on a screen at some distance. If a sensitive film took the place of the screen, there would of course be produced on this film an image which, in the case of the ordinary *positive* lantern slide, would be a *negative*. With a *negative* used as the slide, however, it would be a positive, and the fact is that enlarging lanterns are optically the same in principle as "magic" lanterns.

An enlarging lantern is shown here. This is used in a room, which is illuminated only with red or yellow light, as

[1] See Chapter XVII. on vignetting page, 125.

in the ordinary dark room. The image is received for focussing on a piece of ordinary white paper fixed to a board, the distance between which and the lantern can be adjusted. The further the paper is from the lantern the larger will be the image. The image having been focussed



quite sharp, the cap is placed on the lens, the plain paper is removed from the board—without disturbing the position of the latter—and the gelatino-bromide paper is fixed with drawing pins to the board. The cap is then removed and the exposure commences. This may vary from a minute to an hour. It is greater the greater the amount of enlargement. It varies as the square of the number of times that it is required to enlarge. For example, it is required to make two enlargements from the same negative: one twice as large, the other three times as large as the negative. These measurements are *linear* measurements, not square. Such enlargement is commonly expressed by saying that the one is a "two-diameter" enlargement, the other a "three diameter." The exposures required for these two enlargements would vary as two squared ($2^2$) to three squared ($3^2$),—that is to say, as 4 to 9. The larger enlargement would require fully twice the exposure of the other. Of course the exposure required varies also with the density of the negative, with the lens used, and with the intensity of the light. It is well, if there is any doubt as to the time required, to expose a small piece of paper first on a part of the subject—such as the face—that will serve to indicate satisfactorily if the exposure is right or not, or if not right, will serve to give an idea of how much correction it requires.

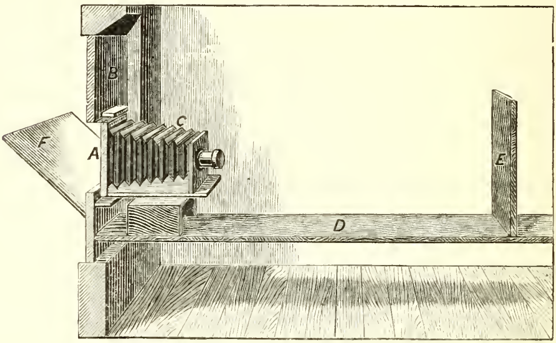
The exposure finished, development, etc., proceed precisely as in the case of contact printing.

The lantern is certainly the most convenient appliance for the production of direct enlargements, and it is, moreover, capable of producing the very best results, but it has one drawback. Except for enlarging *from* small negatives, it is a very bulky and expensive piece of apparatus. Indeed, I am not aware that dealers keep lanterns for enlarging from negatives larger than half-plate. If they are required to enlarge from larger negatives, they have to be specially made. The size that it is necessary to enlarge to is not of consequence.

The best way in which to enlarge from any negative larger than half-plate, and a way, at least, as good as the lantern method for small negatives, is that by daylight. The method is really precisely the same, the only difference being that the negative, in place of being illuminated by artificial light, concentrated by a condenser, is illuminated by diffused daylight.

A darkened room is necessary, and also a camera of some sort which will hold the negative, to be enlarged from, in such a position that it is illuminated by daylight from outside, and which will shut out all daylight except such as passes through the negative, and is required to form the image. Special cameras are made for the purpose of daylight enlarging and are very convenient. It is quite possible, however, to work with an ordinary camera. A dark slide, of the American pattern, in which the shutters draw completely out, is required, but otherwise any camera just as used in the field is fitted for enlarging work.

The following cut will show the arrangement. C is an ordinary landscape camera, placed with its dark slide end against an opening cut in a shutter B. At A is the American dark slide, with both shutters withdrawn; holding the negative to be enlarged from E is a board for holding the focussing paper, and afterwards the sensitive film. It is adjustable along the board D. F is a screen covered with white paper, and adjusted at an angle of about 45°, with a horizontal or perpendicular line. Its function is to show an even diffused light behind the negative. When the




window looks to the north, it is possible, by sloping the board D, so that the camera has the sky behind it, to dispense with the board F.

In working the arrangement, a rough adjustment for size of enlargement is made with the board E, and the final sharp focussing is performed by racking the front of the camera.

The exposure will average perhaps a third or a fourth of that required with the lantern. The same rule as to the relation of number of times enlarged and exposure holds good in using daylight as with the lantern.

A word as to the lenses best suited for enlarging. It is possible to enlarge with any lens; but a single landscape lens is not suitable for enlarging from negatives of architectural subjects, for the same reason that it is not suitable for photographing them. With the lantern it is almost necessary to use a portrait lens, or one of the modern very rapid forms of landscape lenses, on account of rapidity; but in the case of daylight enlarging a lens of the rapid rectilinear or rapid symmetrical type is probably the most suitable. A single lens may, however, be used except for architectural subjects or others, with long straight lines near the margin of the subject.

A thing to be avoided is the use of a lens of too short focus. The focal length of the lens used for enlarging should be at least half as great again as the length of the plate enlarged from. It is particularly necessary to observe this when a portrait lens is used.

### *Vignetting direct Enlargements*

When it is desired to vignette a direct enlargement, the vignetting is done by shading the edges during the exposure with a shade having in the middle of it an opening, of the shape desired for the vignette, but much smaller. This vignetter is then fixed between the lens and the sensitive paper, but nearer the former. The right position must be determined by trial. The larger the aperture of the lens, and the nearer the shade to the lens, the greater the softness of gradation. If, therefore, the aperture of the lens be comparatively small, it is necessary to have a comparatively small opening in the vignetter, and to fix the latter nearer to the lens than if there be a large aperture. It is fortunately very easy to judge of the effect on the screen before the sensitive paper is pinned in position.

# CHAPTER XX

## SILVER PRINTING—*Continued*

### *"Rapid" Printing Process*

THE process which bears the above name may be said to lie about midway between the gelatino-bromide process, already described, and the gelatino-citro-chloride process to be described in the next chapter.

In the first-mentioned of these the paper is coated with a gelatino-bromide emulsion; the exposure required is very short, and the range of tone is very small, the prints being of an engraving black, or of a colour approaching thereto, and being, therefore, not amenable to toning.

In the second process the paper is coated with gelatino-citro-chloride emulsion, prints out like sensitised-albumenised paper, and is toned in a similar manner.

The rapid paper is coated with a chloride of silver emulsion, or a bromo-chloride of silver emulsion,—that is to say, an emulsion consisting of both bromide and chloride of silver suspended in gelatine. The emulsion is slow, and is always, or at any rate sometimes, prepared in the presence of a large quantity of free acid. It has been said by manufacturers of the paper that it is not of much consequence (the presence of free acid and other conditions being observed) whether the emulsion be of bromide of silver, or of chloride of silver, or of a mixture of both.

Advantage is taken, in working the process, of the fact that, in the case of paper coated with an emulsion, such as that indicated, it is possible to get, by a very prolonged exposure — one several hundred times as long as that necessary to produce an image in all its detail—and the use of a weak and very heavily restrained developer, an image of a red colour, which may afterwards be toned with gold. The advantage of the process may be said to be that, by its means it is possible to produce, by exposures to artificial light, prints having all the range of tone that is shown in prints on albumenised paper.

It is possible to get, in fact, a very wide range of really beautiful tones. There has, however, been found by some a difficulty in getting a number of prints of uniform tone. It is probable, however, that this difficulty would be overcome were the process as long practised and as well understood as has the process of printing on albumenised paper, or it might, indeed, be urged that "variety is charming."

### *Exposure of the Paper*

The paper is ordinarily exposed by contact, but the writer has seen some very fine enlargements done on it, the exposure being by daylight, with a rapid lens of the portrait form, and being pretty long even then. The exposure to artificial light would be so long as to be entirely out of the question.[1]

The exposure required by contact is a second or two to ordinary diffused daylight, at a foot from an ordinary fish-tail gas-burner from three minutes, for a thin negative, upwards, perhaps about eight minutes being required for an average negative. By using a duplex paraffin-lamp as source of light, with a bright tin reflector behind it, and by placing the frame, say 8 inches from the light, the exposure may be reduced to $\frac{1}{15}$ or $\frac{1}{20}$ of those required with an ordinary fish-tail burner.

No image is visible with a negative showing average contrast. With one of very strongly marked contrast the shadows will be just faintly visible. It may be useful, as a criterion of the exposure necessary, to say that in the

[1] See Chapter XIX. for detailed descriptions of enlarging by daylight and artificial light.

case of a quality of negative, by no means uncommon in modern dry-plate work, especially in the case of landscapes, one having bold contrasts, but a considerable veil even in the deepest shadows, a scratch made in the film—of course in practice quite at the edge—should just show faintly after exposure.

The paper, being comparatively slow for development paper, may be manipulated in quite a bright red, orange, or yellow light, or even in a moderate amount of gas or lamp light. Thus, if it be not exposed for any very long time to the light, it may be manipulated at 10 to 15 feet from an ordinary fish-tail burner burning at its full strength.

*Developing the Prints*

The following may be taken as a typical developer for working "rapid" paper, although it is, of course, only fair to use, with any brand of paper, the formula recommended by the maker. The following solutions are made up:—

| | | |
|---|---|---|
| A | Oxalate of potash | 4 ounces |
| | Bromide of ammonium | 100 grains |
| | Warm water | 1 pint |
| B | Sulphate of iron | 1 ounce |
| | Water | 20 ounces |

Both solutions are made perceptibly acid to test paper, and enough is taken of each in equal quantities to fill the developing dish to a depth of at least half an inch. This dish, by the way, must be at least an inch each way larger than the prints to be developed.

The solutions are mixed just before development is to begin, by pouring the iron into the oxalate of potash solution, not the potash into the iron.

The prints are placed dry in the developer, not more than two or three at a time, and are kept in continual motion till development is complete. The image must be watched very closely, as it loses nothing of its depth in the after processes, and must, therefore, on no account be allowed to develop to a deeper tint than is finally required.

Indeed, the development is liable to continue for a little time, if the prints be placed, after development, simply in cold water. For this reason the writer recommends that a solution of bromide of ammonium—10 grains to the ounce or so—be prepared, and that the prints be passed directly into this after coming from the developer. This solution will at once stop all action. Whether the prints go first into a dish of clean water or of a solution of bromide of ammonium, they must be passed within a few seconds into a second bath containing clean water, and then into a third, it being essential to prevent a tendency towards yellowness in the whites to wash the developer out of the paper very rapidly. The developer may be used for as many prints as can be developed within half an hour, but must not be used for a longer time than that after the first print has gone into it.

The colour of the prints, as they come from the developer, if it be desired to gain any colour other than an engraving black, should be something approaching a dusky or brick-red.

The prints, after they have been washed, by being passed rapidly through three or four waters, and being left for a few minutes in the last, are passed into a saturated solution of alum, where they remain for quarter of an hour. They are then again washed by keeping them rapidly moving in changes of water for quarter of an hour, when they are ready for toning.

I should mention that various other developers, besides that given, may be used with the paper, for example, ferrous citrate, or a simple aqueous solution of hydrokinone.

### *Toning the Prints*

The following toning formula is that recommended by one maker of the rapid paper :—

| | |
|---|---|
| Acetate of soda . . . . | 60 grains |
| Chloride of lime (fresh) . . | 4 „ |
| Chloride of gold . . . | 2 „ |
| Water . . . . . . | 1 pint |

The water is poured hot into the acetate of soda and chloride of lime, and the gold is added when the solution has become cold.

The prints, by the time that they have reached the toning stage, may be manipulated in dull daylight—in fact, just as prints on albumenised paper.

The toning proceeds rapidly as judged by reflected light; but if the prints be removed from the toning bath when they have acquired the desired colour on the surface, they will "go back" to such an extent in the fixing bath as to appear wofully undertoned. If they be toned to a deep· purple by reflected light, they will give a fine brown after fixing. If any colour deeper than this is required, it is best to judge by looking through the prints.

Warnerke recommends a bath for toning and fixing at one operation. Such a bath may be made by adding 1 grain of chloride of gold to each 4 ounces of a solution consisting of 5 ounces of hypo to the pint of water. Much trouble is saved by working in this way, and the method has the advantage, that by its use it is possible to judge more easily of the colour, because we can judge by reflected light, the prints not changing appreciably after they come from the bath.

### *Fixing the Prints*

This operation is performed exactly as directed for prints on albumenised paper. If the prints have been toned in the bath just mentioned, it is by no means absolutely necessary that a second fixing bath be used; but its use probably increases the chance of permanency in the prints.

After fixing, the prints are washed in the same way as are prints on albumenised paper. The various methods adapted to finishing and mounting of prints on rapid paper will be treated of in a future chapter on "Mounting, Enamelling, and Finishing Prints.

The greatest care must be taken to prevent any trace of hypo from getting into the developing solution, or of developing solution from getting into the toning bath, otherwise failure is certain to ensue.

If vignettes be attempted, they should always be developed in fresh solution, to ensure purity in the white margins.

# CHAPTER XXI

## SILVER PRINTING—*Continued*

### *Gelatino-Chloride Papers for Printing Out*

By reference to our chapter "On the Chemistry of Silver Printing,"[1] it will be seen that the presence of nitrate of silver in excess is necessary to get a bold print in chloride of silver when albumen is the vehicle. Chloride of silver, without the presence of nitrate, giving but a poor image.

The same remark applies when gelatine is the vehicle, except inasmuch as there are certain organic salts of silver which may be substituted for silver nitrate.

There are objections to the use of free silver nitrate in connection with gelatine, because a compound of silver and gelatine is formed, which it appears to be impossible entirely to eliminate, and which, therefore, causes eventually a darkening of the whites of any prints which may be formed on a film of gelatine in presence of free silver nitrate. The same does not apply to such organic salts of silver as the citrate and acetate, whilst these have the effect, when used in conjunction with chloride of silver suspended in gelatine, of producing brilliant prints.

The salts are produced in suspension in a solution of gelatine by what is known as the emulsion method. A few words on the preparation of the paper will be given at the end of the chapter; but in the meantime I shall go on the assumption that the photographer has either made or purchased his paper, and wishes to print with it.

[1] Chapter XIV. p. 103.

The paper is sold by several firms under such names as "Aristotype," "Chloride of Silver," "Emulsion Paper." It keeps well, considerably better than the best preserved papers that the writer has had experience of, and is ready for use at any time. It gives prints of exceeding brilliancy, and is especially useful for getting impressions from very thin negatives. It will give a brilliant print from a negative from which only very poor results can be got on albumenised paper. From this it might be inferred that, of necessity, it would give a hard print from a brilliant negative, and it is true that from a negative of the type which is *all but too hard* for printing on albumenised paper, but yet gives good results on such, only hard prints can be got on gelatino-chloride paper; but with the ordinary run of good plucky negatives suitable for printing on albumenised paper, good results are to be got also on gelatino-chloride paper. The character of the prints on the two papers is entirely different, in a way that it is not easy to explain, but they are both good.

The only drawback to the paper is its price, which is at present much greater than that of even the most expensive sensitised-albumenised paper. This ought not to weigh much with the photographer, who should never sacrifice excellence to cheapness, and I have no hesitation in saying that the results on gelatino-chloride paper are better than those on albumenised paper, at any rate when it is necessary, as it sometimes is, to make the best of a somewhat thin negative.

It seems probable that the prints on gelatino-chloride paper are more permanent than those on albumenised paper, and this for two reasons: (1) Neither the gelatine nor the paper has during any part of the process been in contact with free silver nitrate, which is one undoubted cause of the fading of prints on albumenised paper; and (2) more gold is taken up in the toning process. Indeed, the writer has reason to believe, as he will hereafter explain, that in this process it is possible entirely to replace the silver compound, replacing it entirely with gold to form the image.

*Manipulation of Gelatino-Chloride Paper*

The paper is printed in the usual way. The time taken is shorter than that required for albumenised paper, perhaps one-half as short or thereby. It is, as in the case of albumenised paper, necessary to allow for future reduction by over-printing in the first place. The prints when they come from the frame are set on one side and will keep, if desired, for months before they are toned.

The following toning bath is a modification of that issued by a certain maker of the paper. It has been selected by the writer from a number tried by Mr. Lionel Clark, who some time ago showed the results of various developers on the gelatino-chloride paper :—

| | |
|---|---|
| Chloride of gold . . . . | 1 grain |
| Hyposulphite of soda . . . | 1 ,, |
| Sulphocyanide of ammonium . . | 20 ,, |
| Water . . . . . . . | 3 ounces |

The sulphocyanide of ammonium and the hyposulphite of soda are dissolved in 2 ounces of water, the chloride of gold in 1 ounce, and the gold solution is poured with stirring into the other.

Somewhat more than 2 grains of chloride of gold is, in my experience, required for each 22 × 17 inch sheet of the paper ; but as it is possible to add gold as the process proceeds if it be found necessary,—as indicated by a stoppage of the action,—it is best to start with a quantity not larger than 2 grains of gold chloride to each sheet—6 ounces of toning solution that is. It is scarcely possible to work with less than this, as any smaller quantity of solution is too little to permit of the manipulation of the prints in it.

The prints are washed for a few minutes only—say three minutes—before toning, and here it may be well to give a word of warning. The gelatine, which is used in at least two commercial brands of the paper, is very soft and soluble, and care must be taken never to hold the paper by one place, between the finger and thumb, for any length of time, or portions of the film will be dissolved away. The writer has seen an operator holding a small print for a few seconds on the points of his fingers and thumb when, quite suddenly, the film dissolved away over the spot where handled at the back of the paper. Of course it will be thoroughly understood that the remarks just made apply only to the paper in the wet state. For the same reason that the paper must not, whilst wet, be handled carelessly with warm fingers, so also care must be taken never to warm any of the solution through which the prints pass. Thus the toning solution must on no account be warmed if the process be progressing sluggishly, as it may be when albumenised paper is being worked. Indeed, when the weather is very hot, it may be necessary to cool the solutions artificially with ice. They should never rise above a temperature of 65° F.,—that is to say, any solutions used before the alum solution, which latter would probably do no harm were its temperature as high as 75° F.

As the prints go into the toning solution a sudden (and generally a very disagreeable) change will probably take place. They will become of an exceedingly sickly yellow colour, and will possibly appear of a very uneven colour at this particular stage. This, however, is not of consequence, as the inequality of colour disappears as the toning proceeds.

It is a little difficult to judge of colour at first, the difficulty being somewhat the same as that mentioned in connection with the "rapid" printing process in the last chapter. The case is not exactly the same, however. If we judge of the colour of our print by reflected light, by looking *at* it, it is sure to be undertoned eventually. If, on the other hand, we judge by looking *through* it, it will probably appear somewhat overtoned when complete,—that is to say, toned to a deeper colour than we saw when looking through it. By bearing in mind, however, that the eventual tone will be somewhere between that seen by looking *at* the print and that seen by looking *through* it, but somewhat nearer the latter, it is easy with a little practice to get good and uniform results. Again, as in the case of the "rapid" purple, if the prints be toned just till they show a dark purple when looked *at*, they will eventually give a fine brown.

One advantage the process has, it appears to be impossible to overtone in the sense in which it is possible to overtone a print on albumenised paper. If a print on this latter paper be kept in the toning bath for too long a time the colour changes to a slaty tint, and all the depth and brilliancy of the print is gone. The chloride paper, on the other hand, appears never to go beyond an engraving black. The writer has left prints, already toned to a deep black, in a still active toning bath for a full half hour, and they have suffered no degradation of tone—have merely still remained black; and this fact causes him to believe that it is possible with gelatino-chloride paper to replace the *whole* of the silver image with gold, and therefore to get prints of great permanency.

The prints, when they have reached the right colour, are passed directly—without intermediate washing—into a fixing bath, which may be made up of—

| | |
|---|---|
| Hyposulphite of soda . . | $2\frac{1}{2}$ ounces |
| Water . . . . . . | 1 pint |

They remain here for ten minutes or so, with frequent movement, and must then be carefully washed. This is about the most troublesome part of the business if an automatic washer of some kind be not used, because, as has already been stated, prints cannot be thoroughly washed unless they be kept continually moving; and it is advisable to manipulate the gelatino-chloride prints as little as possible till they have been in the alum bath. Still they can be changed from dish to dish by hand as described for prints on albumenised paper, if due care be taken. If they be kept constantly moving, half an hour of washing is sufficient. After this washing the prints go into a saturated solution of alum for quarter of an hour. This greatly hardens the film, which may afterwards be manipulated with great freedom. The prints are now once more washed to rid them of the last trace of alum. A washing of quarter of an hour, with continual change of water and motion of prints, should be sufficient for this.

The prints may be dried in the same way as prints on albumenised paper, but they must never be left for any time pressed between blotting-paper. So dried, they look very well if mounted and rolled; but many prefer the exceedingly brilliant effect produced by mounting the prints wet on glass which has been treated with French chalk, allowing them to dry thereon, and then stripping them.

### *The Manufacture of Gelatino-Chloride Emulsion for Printing Out*

The description of this process must be very brief, and is indeed inserted only for the sake of completeness, as it is probable that few will attempt to make their own gelatino-chloride paper.

The most complete work on the subject that the writer knows consists of a series of articles by W. M. Ashman and R. Offord, running through the *Photographic News* for the years 1885 and 1886. The following information is abstracted from these articles. The instructions given are on the assumption that the reader is familiar with the ordinary manipulation of emulsion work. It would be impossible to afford space to describe these.

Two separate emulsions are made in the following manner:—

#### (1) *Chloride of Silver Emulsion*

For this are taken—

| | | | |
|---|---|---|---|
| A | Ammonium chloride . . | 53 | grains |
| | Gelatine . . . . . | 420 | ,, |
| | Water . . . . . . | 20 | ounces |
| B | Silver nitrate . . . . | 150 | grains |
| | Water . . . . . . | $\frac{1}{2}$ | ounce |

(2) *Citrate of Silver Emulsion*

| | | | |
|---|---|---|---|
| A | Citrate of sodium | 30 | grains |
| | Gelatine | 100 | „ |
| | Water | $3\frac{1}{2}$ | ounces |
| B | Nitrate of silver | 45 | grains |
| | Citric acid | 80 | „ |
| | Water | $\frac{1}{2}$ | ounce |

The gelatine in A of the chloride emulsion should be about one-third soft—say Nelson's No. 1—and two-thirds hard—say Heindrich's.

The gelatine in the citrate emulsion A is to be all hard. The solution A for the citrate emulsion is to be prepared as follows :—

The gelatine is dissolved by soaking in 3 ounces of the water and warming. The citrate of soda is then dissolved in the half ounce of water remaining, the solution is warmed, and is gradually added with stirring to the gelatine solution.

The chloride emulsion is completed in the following manner :—

The gelatine of solution A is melted by soaking and warming. The ammonium chloride is added, and whenever it is dissolved, the solution B, slightly warmed, is added drop by drop with continual stirring. The emulsion is then put on one side till it is quite stiff, when it is ready to be washed by passing it through mosquito netting or very coarse canvas, and allowing it to remain for five minutes in each of three or four changes of water. It now requires only to be drained when it is ready for use.

The citrate emulsion is mixed in precisely the same manner, care being taken not to raise the temperature of the solution higher than is necessary to secure thorough emulsification. It is washed just as described for the chloride emulsion, and then 15 grains of citric acid are added.

The two emulsions are now remelted and mixed, and are ready to be used for coating paper.

Any very pure paper, which is perfectly white and is well sized, may be coated with gelatino-citro-chloride emulsion; but it is evident that commercial makers coat their paper with an insoluble, or semi-insoluble, substratum of gelatine, containing a white pigment. Probably the "single" transfer paper used in carbon printing would suit the purpose.

The paper may be coated in any of the ways afterwards described for coating paper with carbon tissue, or may be coated as described by Ashman and Offord in their articles in the *Photographic News* already referred to.

# CHAPTER XXII

## SILVER PRINTING—*Continued*

### *Defects in Silver Prints and their Remedies*

THE worker at the various processes of silver printing is certain before long to come across various annoyances in the way of defects in one or other or all of the processes of silver printing that have been described. Sometimes the defects are more or less difficult to trace to their origin, and consequently to stop them is difficult; but, as a rule, it is not necessary to do much more than mention the cause of the defect, when the remedy will readily be found. In the next few pages there are given all the defects with which the writer is acquainted, and their remedies when they are remediable.

Each of the four principal silver printing processes that have been treated of—printing on albumenised paper, gelatino-bromide printing, "rapid printing" by development, and printing on gelatino-chloro-citrate paper—are all touched on.

### *The Prints Refuse to Tone*

In the case of *albumenised paper prints* the cause may be any one of several. A good deal has been said on toning in previous chapters, and amongst other things it has been mentioned that preserved paper is much more difficult to tone than that prepared on a neutral bath, and that, moreover, double albumenised paper takes longer to tone than single. In a weak bath it may be found *impossible* to tone some brands of double albumenised-sensitised paper. The remedy is to strengthen the bath with chloride of gold. Another cause may be acidity of the toning bath, which should always be kept on the side of alkalinity. Again an extreme degree of cold may prevent the action of the toning bath completely. In this case it may be warmed, but should never be raised to a higher temperature than 70° F.

If paper prepared at home refuses to tone, the sensitising bath should be looked to. If this be acid or be much loaded with organic matter, there is certain to be difficulty in getting a good tone.

If a toning solution used time after time, such as the acetate, refuse to tone, it may be suspected at once that the gold has been thrown down. The bottle should be examined for any black powdery deposit which is really gold. A bath which is to be used repeatedly should be frequently filtered, as the presence of any organic matter in it is likely to throw down the gold, and when once it is thrown down, the bath may be at once rejected.

*Rapid Paper Prints.*—If these prints refuse to tone, the cause probably is that the iron of the developer has not been thoroughly washed out of the paper, and that it throws down the gold from the toning solution. If, however, attention be paid to the directions given, this defect should not arise. In the writer's experience the paper varies a good deal in its amenability to the toning process, some brands toning more readily than others, and indeed some batches of the same brand taking much longer to tone than others. If it be found that the prints take very long to tone, the amount of gold chloride should be increased, and the temperature should be raised *a little*, but should never be allowed to exceed about 65°, because a gelatine surface, even when it has been treated with alum, is not insoluble in warm water till it has once been dried.

*Gelatino-Chloro-Citrate Prints.*—The writer has never had any trouble in toning these prints except when the toning bath has been too weak. Here, of course, the remedy is evident. Some, however, have complained that they have difficulty in toning the prints. Ashman has told the writer that where such difficulty exists, it may be overcome by soaking the prints previous to toning for a few minutes in a bath of sulphocyanide of ammonium of a strength of, say, 20 grains to the ounce.

### *The Prints Tone, but the Tone is more or less Lost in Subsequent Operations*

*Albumenised Paper Prints.*—This is a very annoying defect, and one of by no means infrequent occurrence. The tone is all that could be desired in the toning bath, and then, when the prints reach the fixing bath, behold the lovely tone vanishes, and gives place to a dingy hue which can scarcely be described, but which all printers are sure to become only too familiar with at some stage of their experience. It sometimes happens that the tone, lost when the prints first enter the fixing bath, is regained after they have remained there for a few minutes. This *may* be due to sulphur toning, but I believe it merely marks the completion of fixing.

One cause of loss of tone in the fixing bath undoubtedly is insufficient washing before toning. Another is acidity of the fixing bath. These two cases have already been discussed, and the remedy is moreover self-evident. Too *strong* a fixing bath may be another cause of falling off, especially with certain brands of paper. The writer believes that the fixing bath for prints on albumenised paper should never exceed in strength 3 ounces to the pint.

*Rapid Paper Prints and Prints on Gelatino-Chloro-Citrate Paper.*—It has already been stated that a falling off of tone is a thing to be looked for in the case of prints on both these kinds of paper, and that it must be allowed for by pushing the toning operation further than would otherwise be considered necessary. Fortunately, there is not the same liability that there is in the case of prints on albumenised paper to overtone in the sense of going to a disagreeable slaty colour. Possibly a toning bath may some day be discovered for the papers just mentioned, which will permit the prints to be taken from the solution when they have attained that surface colour which it is desired that they should finally possess.

### *The Prints Tone Unevenly*

With all kinds of silver prints there is one common cause for this defect, and it is the failure to keep the prints in motion during toning, and sometimes before. It is, of course, particularly liable to occur when the toning bath is very active, and the prints take but a few minutes to change colour. It may arise from fingering the prints too much, in which case the unevenness will be in the form of finger-marks toned *less* than the rest of the picture. Such marks, if on the back of the print, although very evident whilst the paper is wet, generally disappear when it is dry.

If it be borne in mind that the amount of washing which a print receives before toning materially influences not only the time occupied by the process, but also the colour eventually obtained, it will readily be understood that, if the prints be not kept in motion during the washing which precedes toning, and if in consequence they are unequally washed, unequal toning will probably ensue.

### *The High Lights of the Prints are Yellow, not White as they should be*

*Albumenised Paper.*—The defect generally shows itself only, or at any rate most, in such prints as show wide expanses of white, or of what should be white, as, for example, in vignettes.

It has already been mentioned that paper prepared on a neutral bath will keep but a short time, and that "preserved paper" will not keep for ever. Both turn brown in time, and it is of course not to be expected that pure white can be got from paper tinted to begin with. Still the tint which comes with keeping is greatly reduced during toning and fixing, and is altogether of a much less objectionable nature than that to be described presently.

It should always be borne in mind, in connection with paper prepared on a neutral bath, that it will turn colour as much in the printing-frame as anywhere else, and that, if more than a few hours are likely to be taken in printing, the paper should be backed with "soda paper," as already described.

The yellowness that is most to be feared is that known as "sulphurisation," because it is supposed to be due to some sulphur compound. It very often appears in prints after a few years, and is then—wrongly, in the writer's opinion — termed fading. Unfortunately it sometimes appears during the processes of toning and fixing.

If the prints be allowed to stick together in the first washing water before toning yellowing is likely. They should be passed *rapidly* through the first water. Light during this washing or during toning, if sufficient to act on the prints, appears generally to produce the "sulphur-yellow" or something quite similar to it in appearance.

A slight trace of hyposulphite of soda in the toning solution may produce it, or acidity of either the toning or fixing bath, particularly the latter. I have already several times pointed out that the fixing bath should be slightly alkaline, and I now emphasise my remarks. When preserved paper is used, any acid which may be in it should be got rid of either by repeated washings or by the use of soda to neutralise it, as already advised.

*Rapid Paper.*—The prints on this paper are very liable to be yellow if due care be not taken. The cause generally is that the developing solution is used far too long, or that it is not rapidly enough washed out of the prints when they come from it. It is a considerable safeguard against yellowing to have the developing solutions acid as recommended.

*Bromide Paper.*—Here again yellowness is probably due to the incomplete removal of the iron salts of the developer from the prints. The use of the acid baths recommended *immediately* after development, passing the print directly into the dilute acid without preliminary washing, will ensure absence of the defect, unless it is due to insufficient washing after the acid bath. Care must be taken to remove all the acid from the prints before they go into the fixing bath.

*Gelatino-Chloro-Citrate Paper.*—The only cases of yellowing of prints on this paper that have come within the writer's experience have been due to insufficient washing between fixing and treatment with alum, the alum evidently throwing down some sulphur compound from hyposulphite of soda left in the paper. The remedy is evident.

### *The Prints Lack Contrast*

*Albumenised Paper.*—Leaving out of the question the quality of the negative, which may of course be responsible for the defect, lack of contrast is generally due to the use of too weak a sensitising bath or to too short floating of the paper on a bath strong enough. There is generally, in this case, as well as the want of contrast, a defect termed "mealiness" or "measles," which will be hereafter described.

*Bromide Prints.*—Generally over-exposure is the cause of lack of contrast in these, but it may be due to too strong a developer or to one too old. An oldish developer—one which has been used a few times, and which has not been kept for *very* long, generally works exceedingly slow, but tends to give strong contrasts; but if it be very old or completely worn out, it will fail to give contrast enough.

Of course the defect may be due to faulty paper. If it be determined to use up paper which has been found to be faulty, in the direction of giving prints lacking in contrast, the best will probably be made of it by using a *strong* developer very heavily restrained with bromide, and by giving an ample exposure. A developer made up as follows may be tried:—

| | |
|---|---|
| Saturated solution of sulphate of iron . | 1 part |
| Saturated solution of oxalate of potash . | 3 parts |

To each ounce of the mixture add 4 grains of bromide of ammonium

*Rapid Paper.*—Want of brilliancy in prints on this paper has always been due, in the writer's practice, to over-exposure, it being necessary to strike with some accuracy the mean between that short exposure which will give a heavy, greenish-black image, and that long one which will give a red—and consequently tonable—image, but one lacking in contrast. Mr. Urie, the inventor of an ingenious automatic machine for rapid printing, already described, has told me that better contrast results from a short exposure to a bright light than from a long exposure to a dull light.

### *The Shadows are Heavy and Lacking in Detail*

*Albumenised Paper.*—The defect is always due to the negative, and the methods of treating the negative, so as to avoid the defect—if it (the negative) be not under-exposed, in which case nothing will improve it—have already been treated. Something may be done, as also mentioned before, by sensitising this paper for only a very short time on the ordinary bath, or for a moderate time on a weak bath.

*Bromide Paper.*—The defect can be got over to a great extent with this paper by giving a *long* exposure and stopping the development—which will be very rapid—at a comparatively early stage, thus getting the necessary detail in the lights before the shadows are "blocked up."

*Rapid Paper.*—The same may be said of prints on this paper as of those on bromide paper; but there is scarcely the same power of correction.

*Gelatino-Citro-Chloride Paper.*—As this paper tends to give vigorous prints even from thin negatives, it should not be used for those which show very much contrast, or the shadows are sure to be heavy.

### *Bronzing of Prints*

*Albumenised Paper.*—The bronzing appears only in the shadows which, looked at from a certain angle, have a metallic lustre. Unless the bronzing is very marked, it will disappear in the fixing bath. If it makes its appearance to any very offensive extent, the sensitising bath should be weakened for the particular brand of albumenised paper that shows the defect.

*Gelatino-Citro-Chloride Paper.*—In the commercial brands the defect appears only when negatives of too strong contrast for use with this paper is used. Doubtless a modification in the preparation of the emulsion might result in a paper which would not bronze even with very strong negatives, but the writer has not enough experience on this point to be able to give information.

### *The Prints are Mealy*

*Albumenised Paper.*—The defect consists in a mottled appearance of the shadows. It is generally due to lack of free silver nitrate on the surface of the paper, due to too weak a sensitising bath. The remedy here is self-evident. It may also be due to the use of an acetate bath which has not been kept long enough before it is used.

### *Marks of Various Kinds on the Prints*

It is manifestly impossible to give a description of every kind of spot or blemish which may appear on a print, but mention may be made of one or two defects of the kind which are particularly liable to make their appearance.

*Albumenised Paper.*—*Marble-like markings* are due to scum on the surface of the sensitising bath. *Round white spots* are due to air bubbles. *Metallic spots*—these are of any size from that of a pin-head upwards—are of irregular outline, and of a gray metallic lustre. They are supposed to be due to particles of iron in the paper or in the blotting sheets or boards with which it is dried. The spots are almost sure to make their appearance if the paper be left for a long time between blotting boards after sensitising.

*Bromide Prints and Prints on Gelatino-Chloro-Citrate Paper.*

—Black streaks extending for a greater or lesser distance across the print are generally due to a trace of hyposulphite of soda on the fingers or on the edge of the dish. The *very smallest* trace of this salt is sufficient to produce the defect. The developing dish and the fingers of the operator should be very carefully washed before development is attempted.

# CHAPTER XXIII

## SILVER PRINTING—*Continued*

### *The Treatment of Residues*

EVERY photographer who works any silver printing process on any but the smallest scale will find it well worth his while to preserve the residues. Experienced photographers speak of savings of from 50 to 75 per cent of the total amount of silver used by very carefully saving all waste.

The residues are of several kinds. We may take—

(1) *All Waste Sensitised Paper.*—Any piece of paper spoiled in whatever way, whether it has been printed on or not, should be saved. Trimming should, whenever possible, be performed before toning and fixing, etc. This is possible in all but development processes where it scarcely is. If the bulk of paper becomes very large, it may be burned at any time, the ashes only being kept. A large flower-pot or any such vessel will do to perform the operation in.

(2) *Washings.*—The washings of all kinds of sensitised paper in which there is a soluble salt of silver are worth preserving. Thus the washings of plain or albumenised-sensitised paper, whether the latter have been sensitised at home or not, and of gelatino-chloro-citrate paper should be kept. There is, however, no use in keeping the washings of "rapid" or bromide paper. In any case only the first two, or, at the very most, the first three washings are worth keeping. They should be poured away into a large vessel

of any kind, and the silver should be precipitated in the form of chloride by the aid of common salt. It is a great convenience to use a little chromate of potash as an indicator to avoid the necessity of using a large excess of common salt, which is objectionable, as a means of preventing the possibility of there remaining any excess of silver nitrate, which means a dead loss. After the washing waters have been poured into the vessel, a small crystal of chromate of potash is added. The solution instantly becomes red. Common salt is now sprinkled into the water with stirring till the colour changes to white—which it will do quite suddenly—when it may be known that just enough salt to precipitate the silver has been added. The white precipitate, which is chloride of silver, will gradually settle; when it has reached the bottom, it may be poured away, and the vessel is ready to receive the next batch of washing water.

(3) *Fixing Baths.*—All fixing baths are worth keeping, whether plates or paper have been fixed in them. If the photographer is in the habit of precipitating the silver from his plate fixing baths, he need do nothing more than mix the paper fixing baths with the plate fixing baths; but if he is not in the habit of so doing, the sooner he begins the better.

The fixing baths must be poured into a vessel separate from the washing water, and the silver is precipitated in the form of sulphide of silver with sulphide of potassium, or "liver of sulphur," as it is commonly called.

It is well to have a vessel with some kind of a lid for the fixing bath residue solution, as the sulphide of potassium is an instable body, and gives off sulphuretted hydrogen gas, when it is in the solid form or in solution, and the smell is very offensive. The smell is useful, however, to enable us to know when to add more sulphide. This we may begin by pouring a solution of a few ounces of sulphide of potassium in a pint or two of water into a large vessel. It will smell strongly of sulphuretted hydrogen, and will continue to do so as we add used fixing baths till all the sulphide of potassium has been used up in precipitating the silver out of the hyposulphide of soda solution. Then the smell will cease, and we know that it is time to add some more sulphide of potassium solution. The sulphide of silver settles to the bottom in the form of a heavy muddy precipitate. As the vessel gets full, the water over the precipitate may be removed to make room for more fixing baths, care being taken to remove it only when the contents of the vessel smell of sulphuretted hydrogen, otherwise there will be some waste of silver.

### *Disposal of the Residues*

Many silver refiners and such-like advertise that they give full value for residues of all kinds, and the residues in the various forms already described may be sent straight to the refiner,—that is to say, the burned paper in the first case, the chloride of silver collected from the bottom of the vessel and dried in the second case, and the sulphide of silver similarly collected in the third case.

A great deal of trouble is saved by sending the residues right away to a reducer, and there can be little doubt that most reducers are honest, returning the full value of the residues, less the small fee that they charge for reducing. But it is equally doubtless that some are either dishonest or very unskilful, and that in such cases the return is very disappointing. There is, at any rate, always some uneasiness where there is no means of imposing any check on the refiner, and therefore many prefer to reduce their own residues.

With chloride and sulphide of silver—the precipitates got from the second and third kinds of residues mentioned —thoroughly washed and dried, there need be no uncertainty, as they contain a quite definite quantity of silver. Every ounce of sulphide of silver contains to within about a grain 7 drams of pure metallic silver, every ounce of chloride of silver contains almost precisely 6 drams of metallic silver. In calculating the money values of these residues, it must be borne in mind that, in accordance with the usual intelligence exhibited by us in the matters of weights and measures, we weigh *chemicals*, such as chloride and sulphide of silver, by apothecaries' weight —480 grains to the ounce; when we use them in the laboratory, we sell and buy them by avoirdupois weight, with $437\frac{1}{2}$ grains to the ounce, 16 ounces to the pound. Silver and other precious metals, however, we buy and sell by troy weight, again 480 grains to the ounce, but 12 ounces to the pound.

The following is one way in which the various residues may be treated if we wish to reduce them ourselves :—

Over the paper ashes, placed in a large evaporating dish, there is poured a quantity of a mixture of 1 part of nitric acid to 4 or 5 parts of water. The acid and water are gradually raised to the boiling-point, and are kept at this temperature for some little time. The liquid will then contain most of the silver in the form of silver nitrate. It is separated from the ashes by straining through muslin; common salt is added to precipitate the silver in the form of chloride, and this chloride is added to that got by precipitating from the washings. The ashes are then treated with hyposulphite of soda solution to extract from them what silver may remain in them, and the hyposulphite solution is then added to the vessel for receiving old fixing baths.

We thus have all our residues in the form of either chloride or sulphide of silver, and can, as has already been indicated, readily check their value if we send them to the refiner, all that is necessary being to wash them by adding clean water, stirring up the precipitate with this water, allowing it to settle, pouring off the water, repeating this operation two or three times, then drying the precipitate on a piece of blotting-paper or filter paper. It is a custom with some not to treat the paper residues with nitric acid at all, but to burn it merely, and place the ashes direct in the crucible, with the flux, as afterwards described, for reducing silver chloride. In this case there is no way of knowing beforehand how much silver the residues contain.

Those who have the use of a furnace may themselves reduce the salts to the metallic state in the following manner :—

The silver chloride, thoroughly dried, is mixed with twice its own weight of sodium carbonate, and the mixture is placed in a Stourbridge clay crucible having a cover. Heat is gradually applied. After a bright red-heat has been reached, the lid is occasionally lifted. After a time it will be observed that the silver has been reduced to a metallic state. At this stage the sulphide of silver may be added. The crucible is now once more covered, and the temperature is raised till a white-heat is reached. The heat is kept up for about twenty minutes, when the process may be considered complete. The molten silver may now be turned out into anything which will form a convenient mould for it to harden in; or it may be turned into water, in which case it will be, as the term is, *granulated*, which means that it will be divided into small particles; or it may be allowed to cool along with the crucible, and may be then removed by breaking this latter.

It is commonly considered an advantage to granulate silver, if it is to be used for the production of nitrate of silver, by dissolving it in nitric acid; but I have been told that "cleaner" silver nitrate may be obtained by using the silver in a lump than by granulating it.

### *To Convert the Silver got from Residues into a Printing Bath*

To produce silver nitrate, it is only necessary to dissolve the pure silver obtained by the operations just described in nitric acid, and to "recrystallise,"—that is to say, to continue evaporating the liquid obtained by dissolving the silver till the bulk has crystallised; to pour away the small quantity of liquid which remains, which is to be mixed with the next batch that is to be evaporated; to redissolve in water the crystals left after the residue is poured off; to evaporate once more and to pour away—to go also into the next batch—a residue of the second solution; and finally, to dry the crystals. The object of recrystallising is to get rid of all impurity, and especially of the last trace of free nitric acid, which would be objectionable in many cases where silver nitrate is used. In the case, however, of the preparation of a printing bath any small quantity of free acid may be neutralised, as hereafter described, and for that reason it is by no means necessary to go through the tedious process of recrystallising. The silver may be treated in the manner to be described.

A mass of silver is placed in an evaporating dish, and is covered with a mixture of 1 part of nitric acid to 2 of water. Heat is gently applied by the aid of a sand bath. It will be observed that an action is set up indicated by a certain amount of effervescence. This will by degrees subside, when a little more acid is added. The action is thus kept up with the effect that the mass of silver will gradually be reduced. The addition of nitric acid should be stopped before the silver is entirely dissolved, the heat being kept up for, say, half an hour, after all action has apparently ceased. This will ensure a very close approximation to neutrality in the solution, but will probably leave it still slightly acid. The silver left is taken out, and is retained till the next time of dissolving.

We now have a very strong solution of slightly acid silver nitrate. This is diluted till it reaches the strength at which we wish to work our bath—50 grains to the ounce or whatever it may be. Estimation of the strength may be made in the way described in Chapter XIII., or by the use of the argentometer if it be preferred, as there is not enough of any foreign salt present to upset the reading of this instrument.

The addition to the new bath of a few drops of a solution of carbonate of potash in the manner already advised in Chapter VIII., for the purpose of keeping the bath neutral, will be sufficient to neutralise any free nitric acid which may be present. Enough of the solution must be added to produce a distinct precipitate.

### *To Precipitate and Redissolve an Old Sensitising Bath*

It sometimes occurs that a sensitising bath "goes wrong" or breaks down in an unexplained manner even when all the precautions mentioned in Chapter VIII. have been attended to. In such a case the best course to pursue probably is to precipitate the silver in the form of carbonate, and to redissolve the carbonate in nitric acid.

This may be done in the following manner:—A saturated solution of pure carbonate of potash in distilled water is made, and this solution is poured into the bath which has broken down until the dense precipitate, which at first forms, ceases to be formed by further addition of the soluble carbonate. We now have all the silver at the bottom of our vessel in the form of carbonate of silver, which, as has already been said, is insoluble in water.

It is necessary to wash this precipitate thoroughly. This is done by pouring off the superfluous fluid, adding distilled water, stirring up the precipitate with this, allowing it to settle, pouring off the water, and repeating the operation several times.

Pure nitric acid is now cautiously added to the wet precipitate. A violent ebullition is at once set up, and the precipitate is partly dissolved. The acid is added very slowly till the whole of the carbonate of silver has disappeared. We have now a solution which is almost precisely the same as that got by dissolving the metallic silver in nitric acid, as just described; indeed, except for the presence of slight accidental impurities, exactly the same,—that is to say, it is a strong and probably slight acid solution of silver nitrate. It is reduced to the required strength and neutralised in exactly the same way as the solution got by dissolving the silver. It is better to dissolve all the carbonate of silver with the nitric acid, and afterwards to produce a little more carbonate of silver by the addition of carbonate of soda, than to stop the addition of nitric acid a little before all the carbonate is dissolved, as in the latter case the silver carbonate is likely not to be in a fine enough state of division to act as a means of carrying down the organic impurities of the bath as described in Chapter VIII.

# CHAPTER XXIV

## THE CARBON PROCESSES

### *The Powder or Dusting-on Process*

The process known as the powder or dusting-on process is, as I have already stated, the oldest of all carbon processes. It was designed for use with paper or other supports, but was never, so far as I know, very extensively used with flexible supports, and, apparently, is now only used for producing what are known as opalotypes—opal glass being the support.

The general principle of the process has been already described. The appliances required are of the very simplest. Indeed, besides the dishes and so forth needed for fixing, the only essential is a large camel's-hair brush of the mop form. The larger the better, but one of about $1\frac{1}{2}$ inch diameter will suffice.

### *The Powder*

As regards the powder to be used, I believe that any colouring matter in the form of a very fine powder will do. The process having been intended as a permanent process, a colour consisting essentially of carbon was at first looked for, and was readily found in two different forms,—namely, lamp-black and plumbago, both nearly pure carbon; but the operator may select his own colour from any of those that are kept at the colour shops in fine powder, bearing in mind that it is an essential that the grains of the powder be really small, and the smaller the better.

### *The Glass*

As to the glass, that known as pot opal serves well. It is essential, to get the most artistic results, that it should be what is called "smoothed" on one side, although it might perhaps be better to call it roughened, inasmuch as the smoothing consists in giving the otherwise polished surface of the glass a grain like that of ground-glass.

### *The Sensitive Mixture*

There is a multitude of formulæ for the powder process, almost any organic colloid body which is hygroscopic, and which is rendered sensitive to light by the addition of a certain amount of bichromate of potassium or bichromate of ammonium serving the required purpose.

The following four formulæ may be taken as typical :—

No. 1.

| | |
|---|---|
| Dextrine | 4 drams |
| Grape sugar | 4 ,, |
| Bichromate of ammonia | 4 ,, |
| Water | 10 ounces |

No. 2.

| | |
|---|---|
| Gum-arabic | 7 drams |
| Grape sugar | 3 ,, |
| Bichromate of potash | 5 ,, |
| Water | 10 ounces |

No. 3.

| | |
|---|---|
| Honey | 90 grains |
| Albumen | 90 minims |
| Bichromate of ammonia (saturated solution) | 150 ,, |
| Water | 10 ounces |

No. 4.

| | |
|---|---|
| Honey | 2 drams |
| Glucose | 4 ,, |
| Albumen | 3 ,, |
| Dextrine | 90 grains |
| Bichromate of potash | 4 drams |
| Water | 10 ounces |

These are taken from the *British Journal Photographic Almanac* (1887), with slight alterations, so as to make the measurements be in somewhat the same terms in the different formulæ. The writer has tried various other formulæ, but has failed to find any that worked perceptibly better than those given.

It will be noticed that the last two contain albumen. This is a certain advantage, as the albumen being coagulable with alcohol a ready means of fixing the image is afforded. On the other hand, the addition of albumen involves some additional trouble, as it is necessary to whip it up to allow the froth to settle, and to filter it as already described for albumenising paper.

Nothing particular need be observed in the mixing up of the solution beyond the treatment of the albumen just mentioned. Sometimes a solution mixed up a week or two will work well, but there is no certainty of this, and it may be said that it is always well to coat the plates within two or three days of the mixing of the solutions, and if possible on the same day as they are mixed. Of course it will be understood that whatever solution is used must be filtered.

Light appears to have but little action on the sensitive compound whilst it is yet in the form of solution. It keeps apparently just as well (or badly) in bright light as in darkness.

### *The Transparency*

It is, of course, understood, at any rate it has been stated in previous chapters, that in working the powder process a negative is got from a negative, or a transparency from a transparency. The fact that a negative may be got from a negative is one well worth bearing in mind, as the powder process offers an excellent means of producing reversed negatives, such as are required for single transfer carbon printing and photo-mechanical printing, clear glass being of course used where reversed negatives are required in place of opal glass.

The production of reversed negatives, however, does not come within the scope of this work, nor in truth does the question of the production of transparencies ; but a word at least must be said of these latter. In the first place, if it is essential that the eventual powder picture be not reversed, the transparency from which it is immediately produced must be reversed, and must consequently be produced in the camera ; but I would refer the reader to the chapter on the double transfer process, p. 206, in which I give a number of cases where reversal of the image[1] is not of consequence. It is to be observed further that the transparency must be well exposed, so that the details in the high lights are brought well out. The exposure which would produce a good lantern slide or a pleasing window transparency is too short to produce a good transparency for reproduction purposes, which should have little or no glass left quite clear, should in fact have what I have sometimes heard called a "mucked up" look when considered as an end, not as a means to an end.

### *Preparing the Plate*

The opal plate is carefully cleaned with whitening and water, and is then flowed over with clean water. Whilst it is still wet, the sensitive solution is poured on to it so as to drive the water before it. A good deal of solution must thus be wasted, but this is not of very great consequence as the ingredients are very cheap. The excess of solution is now poured off. The writer must confess that, in working the process, he has found considerable difficulty

[1] It is rather unfortunate that with photographers the term "reversal of the image" is sometimes used to mean two entirely different things : the one the reversal of position in the sense of making what was at the left side appear at the right side and *vice versâ*, the other the reversal which arises from giving an enormously prolonged exposure when in place of a negative a positive is produced. It should be quite clearly understood that when we use the term in connection with any carbon printing process, we refer to the first of the two reversals mentioned.

in getting an even coating of the sensitive mixture, or rather to get a coating that would remain even till the plate was dry; but, on the other hand, he has found little or no evil to result from a slightly uneven coating. A very thin film is all that is necessary to cause the powder to stick, but a film considerably thicker seems to take the powder no more vigorously.

The plate once coated has to be dried, and considerable heat is necessary to dry it. It may be placed in a hot oven, or in front of a bright fire.

The film is not sensitive whilst it is wet, but it is extremely sensitive immediately that it is dry—probably it is no exaggeration to say that in some cases at least it is thirty or forty times as sensitive as sensitised-albumenised paper. For this reason it is necessary to be careful to what light it is exposed, and indeed the writer believes that exposure for some minutes even to a very bright fire may reduce the vigour of the finished print. He therefore advises drying in the oven as mentioned.

The plate dry, the transparency is warmed, the two are placed together film to film in an ordinary printing-frame, the back is adjusted, and everything is ready for the exposure.

*The Exposure*

It has already been stated that the plate is very sensitive. It follows that the exposure is very brief. Of course it depends greatly on the nature of the transparency; but so remarkably sensitive are the films that, with a transparency of average density, the exposure may be in favourable circumstances, with the most brilliant sunshine, less than quarter of a minute. Indeed, five or ten seconds may sometimes suffice.

It is not generally advisable, however, to give such very short exposures as those mentioned, if for no other reason, than that they are not thoroughly under control. A quite visible image is produced, but as the plate cannot be examined during exposure—even if the operator possesses a frame allowing of the examination of an image on a ridged surface—because the damp in the air would affect the result, it is necessary to use some means of estimating the time of exposure required.

The writer in exposing has used as a rough actinometer a piece of sensitised-albumenised paper pinned to the edge of the printing-frame. A few trials with this will enable the operator to form a very fair estimate of the exposure required. With a transparency of average density, the time taken to secure a very light brown tint will probably be sufficient.

*Development of the Image*

When the weather is dry, development may begin at once, but when it is damp, it is advisable to slightly warm the plate before it is taken from the frame. This is done by laying the latter, with transparency and plate still in it, at such a distance from a fire that it will slowly warm. The objection to removing the plate cold from the frame in damp weather is that the film may absorb moisture so rapidly that development will be quite beyond control. With the plate slightly warm there need be no fear of this.

The extreme sensitiveness of the plates has already been mentioned, and as it continues after exposure to daylight, care should be taken that a safe light is used during development. If this operation be conducted by daylight, there must be no more of it than is barely sufficient to enable the operator to work. It is probably safest to work by gas or lamp light, which is quite safe, unless the plate be held within a few inches of the flame.

The plate is held in the left hand in a horizontal position, or, better, is laid on any flat surface. A small quantity of the powder is thrown on to the centre of it, and by a rapid motion of the brush is spread over the whole surface of the film. It must be kept in constant motion till the picture is fully out; a little additional powder being added to replace any dusted by the brush over the edge of the plate.

The image should begin to show before the end of a minute,—that is to say, the image in powder. It has already been explained that there is a quite visible image in the film itself. Nothing should, however, be done to hurry matters till after the end of a minute, or, if the plate has been warmed, till a little time after it has become as cold as the surrounding atmosphere.

If at the end of the time specified no image appears, or if after it has appeared, it gains in strength but very slowly, the plate is gently *blown* upon. Some are in the habit of breathing on the plate, but this is a custom which is rather to be deprecated, as a frequent result is to make the film too damp, and to cause it to be covered all over with powder, producing impure high lights. The result of blowing is to cause a current of a mixture of the breath and surrounding air to impinge on the plate, and this should give just dampness enough to cause the image to come out, if it has not been over-exposed.

### *Fixing the Image*

The object of fixing is to get rid of the yellowness of the bichromate of the film. This is accomplished by the aid of an acid in a mixture of alcohol and water; the object of the alcohol being to prevent the film from being dissolved away along with the powder, as would be the case were an aqueous solution of acid used.

The following mixture has given satisfactory results in the writer's hands :—

| | |
|---|---|
| Methylated spirit . . . . | 8 parts |
| Water . . . . . | 4 ,, |
| Sulphuric acid . . . . | 1 part |

The water and sulphuric acid are mixed, and when the mixture is cool, it is added to the spirit. The whole is then flooded over the plate. If after, say five minutes, the colour has not disappeared, the liquid is flowed off the plate, and 2 parts of water are added. If the mixture still refuses to fix, further additions of water are made, but very carefully. If there be too little water, the colour will not be removed. If there be too much, the image will go altogether, at any rate where no albumen is used in the sensitive fluid. It is a little difficult sometimes to strike the right proportion at once, but once it is hit upon, there need be no further difficulty so long as the same formula and the same samples of acid and spirit are made use of.

The colour completely gone, the plate is soaked for some time in methylated spirit, to get rid of the last trace of acid, when it is set on edge to dry.

The picture is now finished, but must be in some way protected, as anything beyond a touch will rub the powder off. If it be wished to retain the "bloom" of the powder, the plate must be framed with glass in front of it. If not, it is coated first with plain collodion, afterwards with any colourless negative varnish.

### *Defects in Powder Pictures*

The commonest defect is a *want of purity in the high lights.* This may be due to too short an exposure, to incomplete drying before exposure, to too damp an atmosphere during development, or to defective sensitive liquid. Only a little experience and a few trials will show which of these errors is the cause of the mistake. If the error be traced to the solution, it is due to too much grape sugar, glucose, or honey.

*Want of brilliancy of the image* is generally due to over-exposure—too large a proportion of the film being rendered non-absorbent of moisture. It may, however, be due to an attempt to develop in too dry an atmosphere, or to defective sensitising solution. For the former case the remedy has already been given. Concerning the latter, I may say that if the solution be not old, the fault lies in an insufficiency of grape sugar, glucose, or honey, or whatever is used to give the mixture the necessary hygroscopic character.

### *The Powder Process for intensifying Negatives and for producing Reversed Negatives*

The manner in which the powder process may be used to intensify a negative, by coating the plate with a sensitive film on the side remote from the image, exposing the former through the latter, and developing with powder, has already been mentioned. Little further need be added, except that every care must of course be taken to avoid damaging the negative film, and that it is advisable to treat it with chrome alum before it is coated with the sensitising fluid. If it has been varnished, it is quite necessary that the varnish be removed, or the fixing fluid will spoil both the varnish and the film under it.

The powder process is very useful for the production of reversed negatives,—that is to say, those in which right takes the place of left, and *vice versâ*. Of course clear glass is used in this case. The exposure may be slightly less than for pictures, as the absolute transparency of the shadows is not essential, whilst good shadow detail and dense lights are.

The best powder to use is probably plumbago or black-lead. The image developed, fixed, and dried, *must* be coated first with collodion and then with varnish, as described above. All other operations are precisely as described for the production of pictures on opal glass.

# CHAPTER XXV

## THE CARBON PROCESSES—*Continued*

### *The Single Transfer Pigment Process*

The writer, in treating the pigment carbon process, or what is commonly known simply as "the carbon process," intends to proceed as he did in describing the "silver printing process," by treating first the manner of producing a picture on materials purchased ready for use, leaving over to future chapters the descriptions of the methods of producing these materials. He believes that the beginner will make the best progress if he confines himself to as few operations as possible, because then, if he find any defect occurring, he is not troubled with doubts as to whether it is due to defective manufacture of the material, or to his method of manipulating it. Of course, I do not mean to contend that manufacturers never issue defective material; but the chances of defect are enormously smaller when material is produced on a large scale by experienced workers than when it is produced on a small scale by a beginner.

When certain effects are required, it is likely that the photographer may find he gets the best results by making his own sensitive film or "tissue," as it is called, or, at any rate, by sensitising ready-made but unsensitised paper. The question is very much similar to that of albumenised paper, when the photographer who works on a small scale will probably find it best to purchase ready sensitised paper, whilst the printer on a large scale will likely find it advisable to sensitise his own paper, possibly even to albumenise it.

*The Tissue*

It will be already understood, if the first chapters of this book have been read, that the working of the pigment process depends on the fact that gelatine containing bichromate of potash or ammonium (or any of several other salts) remains soluble in hot water for some considerable time if it be kept in the dark, but becomes quite insoluble after a shorter or longer exposure to light.

The tissue, then, is a film of gelatine containing bichromate and also a pigment consisting of some substance insoluble in water in a very fine state of division, this film being generally supported on paper.

Practically any colour of pigment may be incorporated with the gelatine, the colour of the photograph produced depending of course on the colour of the pigment used. Certain colours are particularly suitable for photographic work, as, for example, brown, purple, black, and red (of the colour of red chalk). The two first are those generally used for portrait and landscape work, the two last generally for the reproduction of engravings, red chalk drawings, etc. The red is, however, very effective for a certain class of portraiture. Various other colours are useful for special purposes.

Sensitive tissue may be obtained from Marion and Co. and the Autotype Company in this country. It should, of course, be kept from light and in as dry a place as possible. If these precautions be attended to, it will keep for at least a week, probably for two or three. It is possible at any time to discover whether the tissue is still in good condition by taking a small piece of it, dipping it in cold water for a few minutes, then plunging it in water at about 120° F. If the coloured gelatine dissolves clean away, the tissue is still in good condition. If it do not dissolve away, or if a thin insoluble film come away from the surface of it, the tissue has become useless through long keeping.

*Preparations of the Negative and Exposure of the Tissue*

A negative which will give a very brilliant silver print is best suited for carbon printing, although methods will be afterwards described of getting vigorous prints from comparatively thin negatives. The only preparation the negative requires is the application of a "safe edge." This is simply an edging of any opaque substance extending inwards for about an eighth of an inch and applied to the back of the negative. Bates's black varnish is the most convenient material to use, and this is very readily applied by tying a small colour brush to the side of its stick or

handle, as shown in the sketch, the stick acting as a guide, and allowing the brush to be run rapidly round the negative.

The reason for applying the safe edge is that without it the film may "frill" away from its support during the process of development. The printing may be performed in the common frames, but as it is never necessary to look at the image, the back does not need to be hinged. In the darker tissue the image is quite invisible. In the lighter colours there is a faint, visible image, by which it might be possible to judge of the exposure, but as opening the frame always means the possibility of access of damp to the film, it is best, even when printing light-coloured tissue, not to open the back. Indeed, some good authorities advise that a piece of American cloth be placed behind the tissue, so as to reduce the chance of the access of even the smallest amount of moisture. It is to be understood from the beginning that the tissue must, throughout all operations, be kept as dry as possible.

The image not being visible, it is necessary to have recourse to an actinometer to judge of the exposure. Actinometers are of various forms, but they all depend on the use of ordinary sensitive paper, so placed that the darkening of it may be readily observed, and that the amount of light may thus be roughly gauged. They may be divided into two classes: one in which the sensitive paper is exposed to the full printing light till it turns to a certain shade, when a second piece is substituted or the strip is moved on a stage, each time this is necessary being reckoned as "one tint"; the other, in which a strip of sensitised paper is placed under a screen, having a series of gradations of density, each gradation being marked by an opaque number. With such an actinometer the portions of paper under the most transparent parts print first, as might be expected, whilst the rest takes comparatively longer to show such a tint as makes the opaque number appear visible. The most transparent part is marked 1, the next 2, and so on, and the last figure visible is the one which is read. Thus, if figures 1, 2, 3, 4, 5, and 6 are visible, but 7 is not, it is said that the actinometer has been exposed for 6 tints.

A rough idea of the exposure necessary may be got by saying that the tissue generally issued ready sensitised is about as rapid as albumenised paper. This is, however, but a very rough statement. Many factors tend to alter the sensitiveness of the tissue, amongst others, long-keeping, which renders it more sensitive.

It is well to ascertain, with some degree of precision, the rapidity of the tissue before beginning to print. If a graduated actinometer be used, it is readily ascertained by placing a narrow strip of the tissue and another of the sensitised paper alongside each other under the graduated screen, so that the light acts on both at the same time. The tissue is then developed as described hereafter, when, on comparing it with the strip of sensitised paper, due allowance being made for the reduction of vigour which the last-mentioned would undergo during toning and fixing, and for the fact that the tissue *gains* a trifle in depth in drying, a very fair estimate of the relative sensitiveness may be gained.

With all precaution the beginner can only expect to make several failures, and to gain certainty in timing exposures only by experience, as the differences of density of various negatives can only be gauged by an experienced eye, and the only method of proceeding at first is to try several different exposures till the right one is hit. Fortunately there is very considerable latitude in the exposure permissible, error being corrected during development. It is thus possible with some practice to expose with as much certainty as in the case of ordinary sensitised paper.

### *The Development*

This is performed by the aid of cold and hot water only. The apparatus necessary consists of several dishes either of zinc or porcelain large enough to hold quite comfortably the tissue to be developed, a "squeegee" a couple of inches longer than the breadth of the broadest print, a smooth board or sheet of zinc somewhat larger than the largest piece of tissue to be developed, and some "single transfer paper." This is white paper, coated on its surface with insoluble gelatine.

Four baths should be used, although it is possible to do with only three, by using the first for both cold and hot water; I shall assume, however, that four dishes are used, and shall number them 1, 2, 3, and 4. Nos. 1 and 2 should be large enough and deep enough to permit of the free manipulation of several sheets of paper in each.

Into dish No. 1 is poured cold water, dish No. 2 is filled with water at from 100° F. to 110°. In No. 3 cold water, and in No. 4 a saturated solution of common alum.

Into dish No. 1 is placed a piece of single transfer paper face upwards, and after a few minutes a piece of exposed tissue face downwards. The latter will at first curl face inwards, but after a minute or so it will begin to straighten itself out. Whenever it has become quite flat, or a little before, the two pieces of paper (the single transfer paper and the tissue) are pulled out of the water together. They are laid, transfer paper downwards, on the piece of smooth board or zinc, and the squeegee is applied vigorously to the back of the tissue. The two pieces together are then placed aside with a couple of sheets of blotting-paper below them and another couple above. Further sheets of single transfer paper and of tissue are similarly treated till there is a pile between blotting sheets of perhaps a dozen exposed prints. If it be desired to develop only one or two prints for a trial, they should be left for quarter of an hour or twenty minutes before the next operation begins. If a dozen or so have been squeegeed down, the first will be ready for development by the time the last is added to the pile, and the pile may be turned upside down, so that the first will be at the top.

The first print squeegeed down is now placed in the warm water. After it has been there for a few seconds, a little of the pigment will be observed to exude from between the two sheets of paper. Whenever this appearance becomes pronounced, the two are separated by the fingers at one corner, and the paper which originally supported the tissue is drawn away, and is thrown on one side.

Some warm water is now at once dashed by the hand on to the face of the print. The still soluble gelatine and pigment are washed away, and gradually the image shows itself, at first dimly and buried in pigment, by degrees becoming clearer as the high lights become purer.

If the exposure has been correct, the development will occupy three or four minutes. It may be performed much more rapidly, but this is by no means desirable. Indeed, many good operators prefer to take a much longer time than that mentioned, contending that the slower the development, the more perfect the gradation of the tone. It is at any rate inadvisable to hurry the development in any way unless the picture is over-exposed.

Development should be continued till the picture is just a shade lighter than it is finally required to be, because it gains a trifle in drying as already mentioned.

Whenever it is considered that the picture is sufficiently developed, it is placed in dish No. 3, which contains cold water.

It is quite possible, after a little practice, to have several prints in the developing bath at one time if they be not very large. The lowest one is constantly lifted to the top, and if it appear to be behind the others is treated by dashing water on its face so as to bring it up.

### *Fixing the Print*

The object of fixing is merely, as in the case of the powder process, to get rid of any trace of the orange or yellow colour of the bichromate of potassium which may remain. The alum bath effects this object; besides this, it has the effect of completely hardening the gelatine which forms the image, thereby making it less liable to injury from dampness, etc.

The prints are allowed to remain in the alum solution till the last trace of yellow colour has disappeared. They are then washed, to get rid of the alum, and are hung up to dry. When dry they are finished.

### *Under and Over Exposure*

It is possible, in the carbon process, to compensate considerably for errors in exposure by varying the development.

The indication of under-exposure is that the print is too light, and is wanting in details of the high lights if no attempt be made to compensate the shortness of exposure. If it be observed that the picture is developing too quickly, it should at once be placed in cold water, whilst a bath of water of a temperature of only about 95° F. is prepared. And in this the development is continued. It is very difficult to compensate for any but a very small error of exposure on the under-exposed side if the error be detected only after development has begun. Very often, however, the discovery that one print has been under-exposed is an indication that a number of others suffer from the same defect. In this case a good deal may be done by beginning development at 95° F., and proceeding very cautiously.

*Over-exposure* is more readily treated. The results of it are impurity of the high lights and heaviness in the shadows. In fact, the picture generally is too dark.

In this case the temperature of the water should be raised somewhat, say to 120° F., and plenty of time should be given. It is better to allow a long time to reduce the depth of the print at a moderate temperature than to try to force the development with hot water, except in certain cases. These are where the negative is rather thin, and the prints, when nominally exposed, tend to give an image slightly lacking in contrast. The use of water up to 150° is admissible in such a case, but the writer prefers to keep the temperature not higher than 120° F., and to add a little ammonia—enough to make the water smell strongly—to the bath.

If very hot water or warm water, with an addition of ammonia, be used to develop prints from a fairly dense negative, which have been very much over-exposed, the result will be hard prints.

### *The Continuing Action of Light*

The curious action to which the above title has been given must never be left out of consideration in working the carbon process. By it is meant that, after the print has been taken from the frames, even if it be kept in absolute darkness, the action continues, so that it is possible, by giving a short exposure and keeping the prints for some time, to get proofs quite dark enough.

Foxlee has shown that the action does not take place in an atmosphere that is quite free from moisture, and the fact that the amount of continuating action varies with the dampness of the air makes it difficult to take advantage of the action to shorten exposures, as it is never known precisely how long keeping will be necessary to compensate for a given shortness of exposure. Advantage has, however, at times been taken of the continuating action. Abney says, "When one quarter of the exposure was given, a print hung up in the dark was found to be properly printed in twelve hours; whilst, if only one-eighth, it required sixteen hours."[1] In the writer's experience the effects of continuating action are very much less than these, but, however great or small it be, the existence of the action as a possible disturbing element must never be lost sight of.

[1] *Instructions in Photography*, p. 282.

## CHAPTER XXVI

### THE CARBON PROCESSES—*Continued*

### *The Double Transfer Process*

The disadvantage of the single transfer process just described is that, unless special reversed negatives are used, the prints obtained are reversed as regards right hand and left. It will at once be seen that, for certain pictures, this is fatal. On the other hand, there are some in which the reversal is of no consequence. This is the case in such objects as are "bilaterally symmetrical," which have, that is to say, the two sides precisely the same. It is also the case with many other objects which it may be desired to photograph. For example, if a manufacturer require a photograph of such a thing as a piece of furniture, it does not, in ninety-nine cases out of a hundred, matter whether the photograph represents the article exactly as it was photographed or exactly reversed.

Indeed, the writer is of opinion that the single transfer process might be used in a great many cases when it is generally considered very incorrect to use it, as, for example, in the majority of portraiture. He is well aware that in the case of most people the one side of the face is not precisely the same as the other. Nevertheless, on applying what he considered a crucial test—showing to a number of individuals photographs of others, quite familiar to them, reversed and unreversed—the result appeared to be that the reversal was unnoticed. The individuals who were shown the prints were unable to state which were reversed, which not, unless some particular detail clearly showed it, such as the background, or a side parting of the hair. Nor was there shown any general preference for the unreversed over the reversed pictures. In fact, the writer has no hesitation in saying that, at least in the case of most portraits, there arises no evil result from reversal. The same must apply to all photographs which are of value for their pictorial effect only, as, for example, the majority of sea-scapes.

Allowing, however, for all the cases mentioned, there are still a great many in which reversal is not admissible. In the case of these it is quite necessary either to produce a reversed negative or to have recourse to the double transfer process. The production of reversed negatives is without the scope of this work, but I may say that the photographer will find it best to use the double transfer process in all cases where other than a large number of prints of the same subject are needed. Where more than a few dozen prints from one negative are wanted, it will well repay the operator to make a reversed negative.

The principle of the double transfer process is as follows :—The exposed print is squeegeed on to a surface prepared with wax or some such substance. To this surface it will adhere whilst it is wet, but not when it is dry ; as a consequence, if the print be developed on this surface, as described in the last chapter—if, afterwards, whilst it is still wet, there be applied to it a support, of paper or other material, to which it will adhere when dry, and if the whole be then allowed to dry, the print will leave the support on which it was developed, and will remain on the second one, in which case it will no longer be reversed.

The surface on which the print is first developed is known as a temporary support. Temporary supports are of two kinds—rigid and flexible.

### *Rigid Supports*

The form of rigid support which has found most favour is one of zinc, thick enough to be manageable and finely ground or mulled on one side. An hour or two before development is to take place each sheet of zinc is waxed by carefully rubbing over it with a piece of soft flannel a mixture composed as follows :—

| | |
|---|---|
| Bee's-wax . . . . . | 3 drams |
| Yellow resin . . . . | 6 „ |
| Oil of turpentine . . . | 1 pint |

It is also necessary to get ready the final support on to which the print is to be transferred after development, fixing, etc., are complete. Until quite lately the final support almost always consisted of paper or other material coated on one side with gelatine rendered semi-insoluble by the action of chrome alum. To use it, the support was soaked in water of such a temperature as would render the gelatine slimy. The only objection to this arrangement was that the gelatine tended, by keeping, to become more and more insoluble, so that it was always a question of experiment to discover what temperature of water was necessary to bring the surface into the required condition.

Recently the Autotype Company have been issuing a final support, which is coated with soluble gelatine. This support has only to be soaked in a weak solution of common alum for a little time before it is required, when it is ready for use.

It is best to have the final supports in the alum bath before development is begun, so that no further thought need be given to them till they are required. The bath required is simply a 2 per cent solution of common alum. Into this are placed as many pieces of temporary support as there are prints to develop, care being taken that no air bubbles are allowed to stick to the surface. The size of the pieces of final support should be a little greater than that of the prints.

All being now ready for development, a sheet of zinc is placed in the cold water bath face upwards; an exposed piece of tissue is placed above, is left till it has curled up and straightened out again, and is then squeegeed on to the zinc support. After this all processes are the same as in the single transfer process up to that stage when the print (in this case on the zinc) comes to be dried. It may now be dried or not as may be most convenient. If it be desired to proceed with operations it is not dried, but a piece of the final support is brought down on to it, is squeegeed down, and the two are dried together. When they are dry, they will probably separate of their own accord. If they do not, they may readily be caused to separate by inserting the blade of a pen-knife under one corner of the final support.

### *Flexible Supports*

The "flexible support," which was invented by Sawyer in 1874, consists of paper coated first with insoluble gelatine, afterwards with a mixture of various lacs, so that it is impervious to water, imperviability being the condition necessary to secure the adhesion of the exposed tissue without the use of any special cement.

The chief advantages of the flexible support are its lightness and manageability, the fact that when it is used a number of prints may be manipulated at the same time if desired, and the fact that there appears to be more perfect adhesion between the print and the support when the latter is flexible than when it is rigid.

The flexible support is waxed a few hours before it is required for use, just as described for the rigid support. It can easily be cut to any size, and is most easily managed when a little larger each way than the print.

All the flexible supports that are required for development are placed face upwards in the first dish—that containing cold water—and the exposed prints are placed in the bath one at a time, left there till they are flexible, then squeegeed, one at a time, on to the supports, as already described for the single transfer process, and when rigid supports are used. The operations are further precisely the same as for single transfer till the point where the prints have been fixed in alum and washed. After this, each is brought into contact with a piece of final support, as already described for the rigid support. The two are dried together, when they may very readily be separated.

The flexible supports may be used an indefinite number of times, all that is necessary being to wax each sheet before it is used again, although even this precaution is scarcely necessary after they have been used a few times.

# CHAPTER XXVII

## THE CARBON PROCESSES—*Continued*

### *Lambert Type—Transparencies, Lantern Slides, Opals, etc., in Carbon*

THE carbon process had been published for some years, and had been worked extensively by a few, and in a more or less tentative manner by a number of photographers, when great excitement was caused by the introduction of an improved process by Lambert which, it was thought at the time, would certainly revolutionise the carbon process.

The prints got by Lambert's process—and entitled Lambert-types—showed a marvellous brilliancy of colour and surface, and a depth of shadow detail not seen before.

The brilliant surface was due to the fact that the prints were developed on collodionised glass, and that, being stripped from this when dry, they showed the polished surface of an enamelled print. The enamel is strongly objected to by many, but it appears to render the carbon process much better suited to small work than it otherwise would be.

There can be little doubt that the great excitement produced by the advent of the Lambert-type was, in part at least, due to the brilliant tints which Lambert got by the use of the lake colours; but, alas! it was soon found that these colours were evanescent, and that pictures in them faded, and they had consequently to be given up. It is an unfortunate fact, that it appears to be impossible to get permanent colours of as great richness as some which are not permanent. There is, for example, a certain "bloom" in a silver print that has never been approached in a print in *permanent* pigment.

This is, however, beside the mark. What we have here to concern ourselves with is the practical working of that part of Lambert's process which is available with permanent pigments,—namely, the development on collodionised glass.

Various attempts had been made before Lambert brought out his process to develop on collodionised glass, but all failed more or less, the image either breaking up or, when dry, refusing to leave the glass. The improvement introduced by Lambert consisted in the waxing of the glass before it was collodionised.

Glass plates a little larger than the prints to be developed are thoroughly cleaned, and on to each is poured a little of a solution of

100 grains pure wax.
20 ounces pure benzine.

Glass of any kind will do, but opal glass is to be preferred, as development can so much more readily be judged of with it than when transparent glass is used.

The wax solution is rubbed vigorously over the plate by the aid of a piece of flannel, and what remains is polished with a second piece of flannel or of "papier Joseph," only a little of the wax being allowed to remain.

The required number of plates having been waxed, one is coated on the waxed side with plain collodion. The collodion is allowed to set fairly stiff, and the film is washed with water till the apparent greasiness which it shows at first disappears. This indicates that the alcohol and ether have been washed out of the film.

The plate is now laid film side upwards in a dish of clean cold water. An exposed print is placed face downwards in the water till it has curled up and again straightened itself out. The sheet of glass and the piece of tissue are taken out of the water together, a piece of thin sheet rubber[1] a trifle larger than the print is placed on the back

[1] It is commonly recommended to place a sheet of rubber at the back of a print before squeegeeing it, whatever the support is, and cer-

of it, and the back of the rubber sheet is steadily and gently squeegeed over to bring the tissue into close contact with the collodion film.

Between the time when the tissue is squeegeed down and that when development begins there should elapse about a quarter of an hour, during which time the glass plate and tissue should be under some pressure between sheets of blotting-paper.

Development is performed in the usual way, but must on no account be hurried. Indeed, it is best to let it proceed entirely unaided by leaving the plate, after the paper of the tissue has been stripped from it, lying either in a horizontal position face downwards, or in a vertical position in water of a temperature of about 105° F., till development is so far complete that only a slight rinse with warm water is needed to finish it.

If only a few prints have been printed, they may readily be developed by having a basin of warm water for each. The paper being stripped from the plate, warm water is dashed on to the pigment remaining on the latter to remove air bubbles, then the plate is allowed to rest face downwards on its four corners in the basin. If a number of prints require to be developed on collodionised glass at one time, any of the plate-washers in which the plates stand vertically in grooves may be used, the box being simply filled with water at a temperature of about 105° F.

The prints being developed, fixed, and washed, the final support is applied to them, as described already, and they are placed on one side to dry. When dry the prints strip from the glass with a full enamel gloss.

### *Transparencies in Carbon*

The very easiest method of carbon printing is that whereby such transparencies as may be hung in windows, etc.,

tainly the precaution is a wise one; but the rubber is much more necessary when development is to be performed on collodionised glass than in other cases.

are made. Indeed, the whole process consists in developing a piece of exposed tissue on a sheet of clear glass. No double transfer is ever required, as the transparency may be hung with either side to the light.

A special tissue is sold by most tissue makers for the production of transparencies, the peculiar feature being a larger quantity of pigment than is incorporated in the ordinary tissue. To ensure success this special tissue should be used, but it is quite possible with vigorous negatives and tissue of the ordinary make to produce good transparencies simply by giving a considerably longer exposure than that required for a print.

The very simple method above indicated will result in the production of transparencies that are all that can be desired for window decoration and such-like purposes, but when it is required to produce a transparency of the extremest delicacy and of the highest degree of definition, as for a lantern slide, or for the purpose of reproducing negatives, or when it is desired to reproduce negatives from such transparencies, a slightly more elaborate process gives the best results.

Plates of glass, which for all the purposes mentioned, but especially for the production of lantern slides, should be of good quality, are prepared in the following manner :—

A mixture of 1 ounce of gelatine in 18 ounces of water is made by soaking the gelatine (of moderately hard quality) in 18 ounces of cold water till the former has thoroughly swelled up, then warming the water till the gelatine is melted ; 50 grains of bichromate of potassium are dissolved in 2 ounces of water, and the solution is added to the warm gelatine and water.

The glass plates are coated with this mixture, and the film is allowed to dry in the sun or in the strongest available light.

For transparencies of great delicacy, such as those under consideration, it is quite necessary to use a tissue specially prepared for transparencies, heavily laden,—that is to say, with colour in a very fine state of division. The exposure required is at least 50 per cent greater than that needed for prints.

A piece of the exposed tissue is coated with plain collodion by slightly turning up the edges, flowing a considerable quantity of collodion on to the surface, and pouring away the excess.

The collodion film is allowed to dry, when one of the prepared glass plates is placed film upwards in a dish of cold water. The exposed and collodionised tissue is brought into contact with the glass plate in the usual way, and the two are placed under pressure between sheets of blotting-paper, where they must remain for at least half an hour. Development then goes on in the usual manner, the effect being, of course, judged of by looking *through*, not *at* the image.

To reproduce negatives a positive is first made as just directed, but receives a somewhat fuller exposure than would be considered desirable for pictorial effect, so that no portion remains quite clear after development. From this positive a negative is made in precisely the same way as was the positive.

### *Opalotypes*

The above somewhat barbarous title is generally given to any positive having opal glass for a support. Such pictures are very effective, and are readily produced by the carbon process. All, indeed, that is necessary, if reversal be not considered objectionable, is to squeegee a piece of exposed tissue on to the ground surface of a piece of smoothed opal glass and to develop. If reversal be considered objectionable, the print must be developed on the flexible support and transferred to the opal surface, or a reversed negative must be made to begin with.

The carbon process is applicable to the production of images on many surfaces besides those mentioned. For example, ivory, wood, drawing-paper, and canvas; but for particulars with regard to such applications the reader is referred to special works on the subject.

# CHAPTER XXVIII

## THE CARBON PROCESSES—*Continued*

### *Sensitising Tissue*

SOME good authorities on carbon printing hold that as good results are not to be had with tissue sensitised after it has been otherwise completed than with that sensitised when it is made,—that is to say, that the results got when the bichromate is added to the tissue are not so good as those got when it is added to the liquid pigmented gelatine used for coating the paper.

However this may be, there can be no doubt that the difference is very slight. Moreover, as a great many photographers—perhaps the majority—are not in a position either to make their own tissue or to supply themselves with it whenever they require it, the sensitising of tissue is a thing that has to come under consideration.

Tissue is purchased either in long bands or in pieces cut to certain sizes and packed flat. It is most easily handled when it is in the last-mentioned form, as when once it has been rolled tightly up, it is far from easy to unroll it without cracking the surface.

The sensitising solution is simply a mixture of bichromate of potash and water; and the process of sensitising consists merely in soaking the tissue in this solution.

The strength of the solution may vary within very wide limits. Variations in strength produce considerable variations in result; but this matter will be treated hereafter. Meantime we shall merely consider the use of a bath of what may be considered average strength; and I shall give practical details of the manipulations.

The following bath is made up:—

| | |
|---|---|
| Bichromate of potassium . . | 3 ounces |
| Strongest liquid ammonia . | $\frac{1}{4}$ ounce |
| Water . . . . . . | 80 ounces |

The bichromate does not dissolve in the water very readily. The best way in which to effect solution is to place the bichromate in a muslin bag, to suspend this bag in a jug large enough to hold the water, to pour the water hot into the jug, and to let the whole stand till the bichromate is quite melted. The ammonia may then be added.

Sensitising, as already stated, consists simply in immersing the tissue in the bichromate bath; but before sensitising is begun, it is necessary to take into consideration how the tissue is to be dried, this being a most important matter.

Various points must be particularly attended to. Thus it is essential that the drying be fairly rapid, otherwise the surface of the tissue will become insoluble even in warm water, and it will be found impossible to get pure whites in the prints.

On the other hand, drying may not be accelerated by a rise of temperature other than very moderate, otherwise the gelatine of the tissue, which is generally a somewhat soft variety, will certainly be melted, the result being of course that the tissue is rendered useless.

Where work is carried on on a very large scale a special room may be provided for the drying of tissue; but probably if work be carried on in a scale sufficiently large to justify this, it will be found of advantage to make the tissue from the beginning. The nature of room best suited for drying tissue, if a special room be constructed, will be treated of in the next chapter.

The object is to dry the tissue quickly, at a temperature never exceeding, say 70° F. The tissue should never take more than about twelve hours in drying; and it is an advantage if it can be dried within about eight hours.

No place is better for drying tissue than an ordinary room with an open fireplace. If drying is to be performed during the daytime, of course the room must be specially darkened—not like a dark room for development, but as a room has to be darkened when ordinary sensitised paper is to be quite freely worked. It will generally, however, be found convenient to hang the paper up at night, and to remove it early in the morning. The best way in which to work is to light the fire two or three hours before sensitising begins, to let it blaze up for a couple of hours, so as to thoroughly *dry* the room—this being an essential to rapid drying of the tissue—to let the fire get low when sensitising begins, and to place on it a large "gathering coal," which will keep up a low fire—enough to stimulate ventilation—during the whole or the greater part of the night.

Another thing that has to be considered before we begin sensitising is to provide means for holding the tissue during the time of drying. It is a common practice to hang up the sheets by American clips, but this system has the drawback that some of the sensitising fluid is liable to gravitate to the lower edge of the sheet; the result being that that portion will be more sensitive than the rest, and that printing will not be equal.

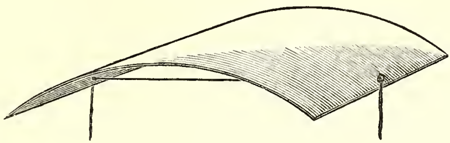
The thing to be especially avoided in sensitising and drying is any unequal distribution of the sensitising fluid; and the thing to be specially aimed at in drying is an equal and rapid action.

Of the various methods of drying recommended by different people I know of none better than that advised by the Autotype Company.

Pieces of cardboard rather larger than the sheets of tissue to be dried are bent into the form of a bow by cutting a notch in the middle of each end and a piece of string stretched across.

All the provisions described as necessary for drying have been made. The process of sensitising which I now describe may begin. First, however, I may say that if the temperature of the bath is above 60° F., it should be cooled to say 50° by the aid of ice.

In immersing the sheets of tissue in the sensitising bath, the great thing to be avoided is the adherence of air bubbles to either back or front. There are various ways



of avoiding this. The following is the way in which the writer manages :—

The tissue is placed face downwards in the bath—an ordinary stoneware dish a little larger each way than the tissue to be sensitised,—the back of the tissue is brushed with a camel's-hair brush to remove any air bells that may adhere. The tissue is then turned face upwards without removing it from the bath, and the operation of brushing is repeated, this time on the face. The tissue is then once more reversed.

Whilst another sheet is being immersed, the first may be left to soak, or, indeed, two or three may be in the bath at one time, but the undermost should be lifted out after it has been soaking for about five minutes. The sheet of tissue, as it is removed from the sensitising bath, is laid face downwards on a clean plate of glass, and the squeegee is passed lightly over the back of it to remove as much of the solution as is thus removable from both the back and the face. It is then laid face upwards on one of the cardboard bows above described, and is laid in what is considered the best condition for drying.

One thing essential in the drying room is that it be free from any gas fumes which would have the effect of rendering the tissue insoluble.

The tissue when sensitised is kept in a dry—and of course dark—place between boards, with a weight on the top. Enough may be sensitised at one time to serve for a week or ten days. Some consider that the tissue is not in its best condition for working till it has been kept for about a couple of days. It must be borne in mind that it will get somewhat more sensitive the longer it is kept. It is always possible to get good results, however, so long as the film is completely soluble in warm water.

### *Strong and Weak Sensitising Baths—To Print from Over-Thin and Over-Dense Negatives*

The strength of bath given above, about 4 per cent, may be taken as a good one for general work; but there may be times when it is of advantage to use a bath either stronger or weaker than that mentioned.

The bath may be varied between 1 per cent and 8 per cent, although it is seldom used weaker than 2 per cent or stronger than 6 per cent.

In general terms, the following are the results of the use of a very weak and a very strong bath:—

A weak bath gives a slow tissue—one that requires a long exposure—which keeps well, and tends to give pictures of great vigour.

A strong bath gives a very rapid tissue which, however, will not keep very well, and which gives very soft pictures.

It is advisable to increase somewhat, say up to 6 per cent, the strength of the bath in very cold weather.

From a consideration of what has been said, it will readily be inferred that tissue sensitised on a weak bath is most suitable for obtaining prints from a thin negative, a comparatively long exposure being given, whilst the best result will be obtained from a negative of density above the average by using a strong bath and giving a comparatively short exposure.

Here let me point out that by a "negative of density above the average," I do not mean a negative hard from under-exposure,—from such a negative it is not possible to get a good print by any process. I assume a negative having all the detail required, and in gradation proportionately correct, but in which there is too great a contrast between the extremes of gradation.

The following is the way in which the best result may be got from a thin negative :—A "transparency tissue is used;" a weak bath, say one containing 2 per cent of bichromate, is employed; the print is made in a moderate light; and the exposure is continued to such an extent that it will be only with some difficulty that the high lights can be brought up to a state of purity. Development is then patiently performed at a somewhat high temperature, a little ammonia being added if necessary, or the clearing of the lights being even helped by very gentle rubbing with a pad of cotton-wool.

To make the best of a very dense negative, the tissue is sensitised in a bath as strong as, say, 6 per cent. Printing is performed in the brightest light possible—an exposure as short as will serve being given—and development being carried out at as low a temperature as possible.

### *To Intensify Prints*

It may be considered desirable to print from a negative which is so thin that even, with the precautions already mentioned, a vigorous print cannot be got. In this case —the best being made of the print possible—it is further intensified whilst it is still on the temporary support.

If it be borne in mind that the image consists of a film of varying thickness of gelatine—the deepest shadows being represented by the thickest portion, the high lights by complete or all but complete absence of gelatine—it will readily be understood that any substance which will uniformly stain the gelatine to a desirable colour will intensify the image.

A solution of permanganate of potash is one of the most commonly used agents. A little permanganate is dissolved in water so that a dark solution is made. This is flowed over the image till the required intensity is reached, more permanganate being added to the solution if it be considered necessary. Finally the image is washed.

Another method, out of many which may be adopted, is to make up a slightly acid solution of pyrogallic acid—say, to each ounce of water 4 grains of pyrogallic acid, $\frac{1}{4}$ grain of citric acid—and just before and during application to add to this a drop or two at a time of a solution of silver nitrate, which may be of a strength of about 40 grains to the ounce.

Probably the latter method will be found to be the best for small work on glass, such as lantern slides, small transparencies, or reproduced negative work; the former for comparatively large work.

It might be supposed that the only thing requisite to obtain a vigorous print from ever so thin a negative was a tissue with a sufficient quantity of contained pigment; but it must be borne in mind that one effect of increased pigment is to prevent the light from penetrating as far as it otherwise would. The result of this is that the increase of brilliancy obtainable by mere increase of pigment in the tissue is, beyond a certain point, very slight.

# CHAPTER XXIX

## THE CARBON PROCESSES—*Continued*

### *The Manufacture of Tissue*

It has already been stated that many good authorities consider that better results are to be had when the bichromate is compounded with the gelatine before the latter is spread on the paper. Certainly where ready sensitised tissue is to be purchased it is to be preferred, and it *may* even in some few cases be advisable to make the tissue from the beginning rather than to purchase it; nor is it so remarkably difficult to do so as might at first sight be imagined.

The first thing is to select a suitable paper. As the paper on which the sensitive compound is to be spread is in no case to form the final support, it is not necessary that any care be taken that the paper is not affected by light—as most or all papers are more or less—but merely that it be of uniform texture, tough when wet, so that it will stand rough handling, and not tending greatly when moistened to expand more in one direction than in another, otherwise an appreciable amount of distortion may supervene.

The following formula has been found to give good results:—

| | |
|---|---|
| Nelson's flake gelatine . . | $2\frac{1}{2}$ pounds |
| Coignet's gold medal gelatine . | $\frac{1}{2}$ pound |
| Strongest ammonia . . | $\frac{1}{2}$ ounce |
| 5 per cent solution of phenol . | 2 ounces |
| Sugar (white loaf) . . . | $1\frac{1}{2}$ pounds |
| Water . . . . | 6 pints |

This constitutes what is called "plain jelly."

The gelatine is allowed to soak in the water for an hour or two, then heat is applied to melt it. It is then kept in constant motion by the aid of an egg beater or small churn, whilst the other ingredients are added.

It may now be allowed to set, when it forms a stiff jelly which will keep for a long time, or it may have the colouring matter added to it at once.

Various colouring matters are used. In fact the number of matters that may be used is almost without end; but probably nothing will be found better for the substance of the colour than Indian ink of good quality. This is simply carbon in a very fine state of division held in suspension in a gelatinous substance. The Indian ink is broken into small pieces, and is left to soak in a little water for twenty-four hours. Some of the plain jelly is then added, heat is applied, and the jelly and lamp-black are ground up together. If an engraving black be required, this colour will do alone, but if a warm purple or brown is needed, alizarine, vandyke brown or carmine is added till the desired shade is got, when the pigment is spread in a very thin layer.

Of the gelatinous colouring matter thus got enough is added to the plain jelly—the latter being at the time warm and undergoing churning—to give a certain amount of opacity. The opacity is best judged of by letting a drop of the jelly set on a plate of glass and looking through it. For an average tissue this drop should show all but opaque against a strong light. For an extra dense tissue, such as is required for lantern slides and reproduced negatives, it should appear quite opaque.[1] Jelly in this form will, if allowed to set firm, keep for a very long time; it may therefore be used at once, or may be kept till it is needed. With the proportions of soft and hard gelatine given above, a tissue of average sensitiveness and average solubility will result. If the hard gelatine (Coignet's) be replaced by soft (Nelson's), the result will be a less sensitive tissue, which

[1] See last paragraph of chapter immediately before, explaining the reason why variation in amount of pigment used does not produce proportionate variation in the final effect.

will keep very well, but which can only be worked in cool weather. If, on the other hand, the quantity of hard gelatine be increased, the tissue will be more sensitive, but will not keep particularly well, and will not be very easy to develop. Such a tissue is useful when it is necessary to work in very hot weather.

Just before coating the paper with the jelly, the bichromate of potash should be added. To the quantity given 6 ounces may be used. It may be added either by dissolving it in the smallest quantity of boiling water in which it will melt, and adding this to the melted jelly, or better, by keeping the jelly in constant motion whilst melted with heat, and gradually adding the bichromate in the form of a powder. It will be understood that increasing or diminishing the quantity of bichromate has the same effect on the after working as has increasing or decreasing the strength of the sensitising bath.

### *Coating the Paper with Sensitive Compound*

There are various methods of coating paper with sensitive compound. When it is coated in large quantities, it is drawn in a continuous band under a roller which is put over a trough containing the compound. The trough is adjustable vertically so as to cause the paper just to touch the liquid. The continuous band of paper coming vertically coated from the trough is carried over a second roller at the top of the machine, the back of the paper touching the roller this time. Before the paper has reached the top of the vertical run the gelatine has set as the motion of the paper is very slow. After it passes the second roller, it may either be hung in festoons, the back only touching the supports, or may be cut in lengths and hung vertically in lengths.

It will be seen that when the bichromate is incorporated with the gelatine, whilst the latter is also in solution, there is no possibility that it can run to the lower part of the sheet as when tissue is sensitised with an aqueous solution of bichromate. There is, therefore, no objection to hanging the tissue in a vertical plane to dry.

Of course none but those who work on a very large scale will make use of a machine. There is, however, an easy way of coating lengths of 6 or 8 feet by hand, which gives very good results. It must be borne in mind in this connection that absolute uniformity of coating is by no means quite necessary with tissue. So long as there is a certain minimum of thickness, the only evil effect of too much material on certain spots is that, such parts take longer than the rest of the surface to dry, and that, if this drying be very greatly prolonged, extra sensitiveness, or even insolubility of the part will ensue, and of course consequent unevenness of result.

The paper to be coated is cut into such lengths that if the operator stands on the ground or on a low stool holding one end of a piece of paper as high as he can, the other will be an inch or two off the ground. A dish which is an inch or two longer than the breadth of the band of paper is filled to a depth of at least half an inch with the sensitive compound in a liquid state. The paper is rolled up into a roll. The roll is laid on the liquid sensitive compound. The moment that it touches it the free end is lifted upwards, so that the roll slowly unwinds itself, always touching the liquid. By this means a surface which is almost or quite even will be obtained. The more rapidly the paper is moved the thicker will be the coating; but with a jelly so thick as that given, a sufficient coating will probably result from moving the paper very slowly.

The second method to be described is due to Bolas. In it two pieces of paper in contact, which may be of any length, are drawn right *through* the sensitive fluid. The result is that the pieces of paper which are back to back are coated each on one surface only, whilst the jelly flows between the two pieces only to a very small distance, in fact, just far enough to cement them together, so that in drying, the edges being fixed together, the tendency to curl towards the coated surface is counteracted.

It is necessary for coating by this method to have a dish into which it is possible to depress a roller or thick glass rod. The two pieces of paper are then immersed by pressing them by means of the roller under the surface of the fluid at a few inches' distance from the end of the pieces of paper. They are then drawn through the liquid, being all the time kept quite tight. On a small scale this may be done by having one operator at each end of the paper, one pulling it through, the other keeping a slight strain on it.

The requirements for drying tissue coated as described are the same as those for drying tissue sensitised in a bichromate solution; but as already explained it may be hung vertically during drying.

If work be done on a very large scale, it may be considered advisable to fit a special room for drying. In such a case the condition to be most fully observed is that there are very large openings for the inlet and outlet of air. These can indeed scarcely be too large. Of course it is necessary so to arrange the openings for ventilation that light does not enter by them. It may be said that there should be at least 1 square foot of area of inlet and outlet for every 1000 cubic feet of capacity of room.

The room may be of such size that the lengths of tissue may be hung at least 2 or 3 feet apart.

Ample ventilation being provided, the room may be warmed by hot-water pipes round the floor. The air inlets should be so arranged that the incoming air impinges on these pipes and is thus warmed. If there be as much area of air inlet and outlet as is indicated, the hot-water pipes will cause a rapid current of air without raising the temperature much, and this is what is required.

Above all things it is necessary in the drying room to avoid the presence of the products of combustion or similar gases. Thus it is better if possible to work in the room by daylight admitted through yellow blinds, rather than by gas or lamp light. Not because the last-mentioned form of light is dangerous through its actinism, but because the products of combustion which it gives off are dangerous, being liable to render the tissue film insoluble.

The tissue when dry may be kept in rolls, but it will be found most convenient to cut it approximately to the sizes required and to keep it flat under pressure. It should be kept in a very dry place.

## CHAPTER XXX

### THE CARBON PROCESSES—*Continued*

### *Defects and Remedies in Pigment Prints*

*Insolubility of the Tissue.*—This is probably the commonest of all difficulties in carbon printing. It is seldom that the whole film becomes insoluble. Only the very surface is generally affected, but this is quite enough to make it impossible to get pure whites in the prints, and also to prevent partly or wholly the adherence of the tissue to the temporary support. I have already stated how it is possible to tell whether tissue is afflicted with insolubility without actually making a print on it.

The cause of insolubility may be any of the following:—

(1) The use of very acid bichromate either incorporated with the tissue or in a sensitising bath.

(2) Slow drying of the tissue or drying in a warm, damp atmosphere.

(3) Drying in an atmosphere contaminated with products of combustion, etc.

(4) Long keeping, especially when there is a large quantity of bichromate in the film.

(5) Keeping in a damp atmosphere.

(6) Exposure to light.

The use of ammonia, as described, will prevent (1) the acidity of the bichromate.

The means of avoiding the other causes of insolubility are evident.

### *Frilling of the Film*

This is by no means a very uncommon defect. The film leaves the support on which it is being developed especially at the edges. This difficulty is particularly likely to arise if the film is insoluble, but it may be met with even if it be not.

It has already been explained that the object of the safe edging of the tissue is to prevent frilling. Care must of course be taken that the tissue is not cut so small that it is entirely within the safe edge, otherwise frilling is sure to result. If it be required to print a small piece only out of a negative, it is necessary to cut out a mask of opaque paper, or much better, of paper of just such a degree of opacity that it will permit a slight tint to print, and to place this mask between the tissue and the negative.

The reason for safe edging on the *back* of the negative, not on the film side, is that if there is an abrupt transition from a quite white margin to a deep shadow in a print the film is liable to frill off. The slight vignetting which results from having the safe edging on the *back* of the negative is enough to prevent this.

Frilling is likely to occur if the tissue be allowed to remain in the cold water too long before it is brought into contact with the temporary support. It should be applied rather before it has quite straightened itself out than after.

If too little time be allowed after the tissue and temporary support leave the cold water and enter the warm, frilling is liable to result.

When tissue is developed on collodionised glass, frilling is pretty sure to occur if the collodion film be scratched, torn, or punctured so that water can get under it.

### *Reticulation of the Film*

is a defect somewhat analogous to frilling, and in fact may be termed frilling. It is therefore likely to be brought about by the same causes which produce the latter defect.

It will also show itself if time enough do not elapse after waxing the temporary support and before using it for development. A few hours at least should be allowed.

Reticulation appears to be particularly liable to occur when development is performed on a collodion film, and it is the writer's experience that it occurs more with tissue quite new, or newly sensitised tissue, than with that which has been kept for a few days. If reticulation show itself very obstinately on development on collodion, it may generally be overcome by giving the tissue a very brief exposure to diffused light before development. This exposure should not be enough to produce a perceptible tint after development.

### *Streaks and Spots in the Prints*

These may be due either to the tissue or to the manipulation during development, etc. Of course, if there are visible streaks and spots in the tissue before printing, it is only to be expected that they will show in the final prints.

Spots in the tissue are commonly due to air bubbles. If there are any of these on the surface of the liquid sensitive compound, they should be skimmed off before coating begins. Of course any solid foreign matter in the compound will produce spots or streaks. If there be any such, the compound should be filtered before use.

Any roughnesses on the surface of the paper used as a support for the sensitive compound, in the form of small prominences, are liable to form nuclei for comet-shaped streaks when the paper is coated. The same remark applies to grease spots. Such streaks are also liable to occur if the gelatine has not been thoroughly churned up to mix it.

When the spots are not in the tissue, they generally arise from air bubbles confined between the film and the temporary support. Air bubbles are very liable to adhere unperceived to the surface of the tissue, and on development to produce spots. It is a good plan to pass the squeegee over the surface of the tissue *under water* just before it (the tissue) is applied to the temporary support.

### *The Prints are too Dark*

This defect is generally due to over-exposure, but may be due to keeping the tissue after printing for even a comparatively short time in a damp atmosphere, in which what has already been described as the continuing action of light goes on very rapidly. The method of making the best of over-exposed prints has already been treated.

### *The Prints are too Light*

This defect generally arises from under-exposure, but if, even when what may be considered a protracted exposure has been given, the prints are still too light on development, the details in the lights being entirely washed away, it may be assumed either that too soft a gelatine has been used in the manufacture of the tissue, or that too little bichromate is incorporated in the film.

### *The Print Developed on Collodionised Glass refuses to leave the Support*

This is due to some fault in waxing the glass. Lambert laid great stress on the necessity for using pure wax and pure benzine. The plate must be very carefully cleaned before it is waxed, the wax must be very carefully spread over the *whole* of the plate, and must not be too completely removed. These precautions must be specially observed the first time a glass plate is used. When a print has once been cleanly stripped from it, it is very unlikely that trouble will result with subsequent prints. If a print sticks to a plate of glass, it is as well not to attempt to use that plate—or at any rate the same side of it—for squeegeeing another print to, even if it be carefully cleaned.

# CHAPTER XXXI

## THE PLATINOTYPE PROCESS

The platinotype process is one, the popularity of which increases daily, and that deservedly in the writer's opinion.

The distinguishing features of the process may be said to be its simplicity, the permanent nature, and the peculiarly artistic colour and general effect of the results.

Although the process is one of development, the image is visible in the printing-frame, and the manipulations during development and afterwards are so remarkably simple that perhaps the platinotype process may be set down as the simplest of all printing processes in its workings.

The permanent nature of the image is a very great point, and is one which must now be admitted on all hands. A long discussion has recently taken place on the subject. It was initiated by Mr. A. Pringle, who contended that sulphur in certain forms might attack the prints. The result of the discussion—during the whole of which, by the way, Mr. Pringle appeared to be entirely misunderstood by those who took up the opposite position—was to show that, although there was a remote possibility that the whites of the prints might yellow in circumstances where they would probably never be placed but for experiment, the actual image may be pronounced to be as unalterable as any image with paper as a support ever can be.

The colour of the image varies from a fine engraving black to a colour called sepia, and somewhat approaching that tint. The surface is the natural surface of the paper, without glaze or " meretricious gloss " of any kind.

By most artist-painters and such-like, platinotype prints have from the first been declared to show great artistic merit; but it has taken a long time to educate the general public to turn from the well-known photographic browns and purples, with a glossy surface, to the colder blacks and the mat surface of the platinotype, but a change in taste appears to be surely coming about.

The following is, as briefly as possible, the general principle of the process :—

Paper is coated with a mixture of chloro-platinite of potassium and ferric oxalate.

The ferric oxalate is sensitive to light, being by its action converted into ferr*ous* oxalate. The result of exposing paper coated as described is therefore that, in the printing frame, an image of ferr*ous* oxalate is produced. This image is of a faint grayish orange colour, the unchanged salts being lemon yellow.

Ferrous oxalate has the effect when *in solution* of reducing chloro-platinite of potassium to metallic platinum. It is then only necessary to dissolve the ferrous oxalate in some liquid capable of dissolving it, when the solution will reduce the chloro-platinite of potassium to the metallic state as metallic platinum.

A liquid capable of dissolving the ferrous oxalate is to be found in a solution of oxalate of potassium. It is only necessary then to float the paper, having on its surface chloro-platinite of potassium, and an image in ferrous oxalate, on a solution of oxalate of potash, when an image in finely divided metallic platinum or platinum-black results. The action of the solution is rendered more energetic by heating it.

After development the remaining iron salts may be dissolved from the surface of the paper by any of several acids.

This process is patented in this country by W. Willis, junr., and is commercially worked by the Platinotype Company, who issue the paper ready sensitised, and the materials for sensitising it.

It would certainly be to the advantage of the general photographer to purchase either the paper or the materials for sensitising it ready-made, even if he were licensed to produce them himself. The writer, however, thought that experimentalists might care to try their hand at the production of the paper from the beginning, and had an idea of giving instructions for so doing; but after reading the best work on the subject,[1] and making a few experiments, he concluded that the work was only such as could be undertaken with advantage either by a highly-skilled chemist or by one who intended to go in for it elaborately and on a large scale, to neither of which would such instructions as could be given here be of much use.

I therefore proceed to the manipulation of the paper as purchased ready sensitised, and afterwards to the method of sensitising the paper with materials purchased from the Platinotype Company.

The point which must be most carefully observed in connection with the paper which is purchased ready sensitised is that it be kept absolutely dry. It is bought either in a "calcium tube" or in a roll of waterproof paper. In either case, it must be stored in the calcium tube. This consists in a long cylindrical box, having in the lid a space filled with asbestos, which has been soaked in calcium-chloride. The calcium-chloride absorbs moisture greedily, keeping the paper which is in the tube quite dry. When the calcium has absorbed so much moisture that it is perceptibly damp, it may be dried on a shovel or in an iron ladle over a bright fire.

It is necessary to take precautions against damp at every turning. Thus the paper in the printing-frames must be covered at the back with sheets of india-rubber, and the prints, when taken from the frames, must be returned to a calcium tube. There should be as little delay as may be in placing the paper in the frames and in taking it out. It is advisable—at any rate in very damp weather and especially when the film is unvarnished—to

[1] *Platinotype*, by Captain Piryzighelli and Baron A. Buhl, translated by the late J. F. Iselin, M.A., and edited by Captain W. de W. Abney, R.E., F.R.S. London: Harrison and Sons, 59 Pall Mall.

warm the negative in front of a bright fire just before the paper is placed in contact with it, as gelatine is quite perceptibly hygroscopic, and a negative film absorbs, in damp weather, quite enough moisture to effect a platinotype print during exposure. The result of damp is degradation of the whites of the print, and a general lack of vigour.

### *Exposure of the Paper*

Platinotype paper is considerably more sensitive than sensitised-albumenised paper—probably about three times as sensitive. It must therefore be more carefully handled in the light.

The negative that is best suited for the production of platinotype prints is one having vigorous contrasts, as the contrast given by platinotype is as a rule somewhat less than that got on albumenised paper, the same negative being used in both cases.

The image is of a grayish orange tint. At first it is a little difficult to judge by examining it when the exposure is sufficient, but after a little practice it is very easy. According to whether it is decided to develop in a very hot bath or in a comparatively cold one (a question to be treated of presently), the exposure is continued till the shadows and half tones only are visible, or till all detail, even in the lights, can be distinguished.

### *Development of the Image*

The developer for the prints is an aqueous solution of oxalate of potash. Within considerable limits the strength of this solution is not of consequence. It is therefore common to use a "cold saturated" solution. This should be rendered just perceptibly acid by the addition of a little oxalic acid.

The developer is always used more or less hot. The Platinotype Company and others advise that we give such exposures that development may be performed at a temperature of about 180° F.

It is to be understood, however, that any temperature between 100° F. and the boiling-point may be used, the lower temperatures involving longer exposures, and some prefer to expose the longer time and develop at comparatively low temperatures, claiming that they thereby get pure whites with greater certainty, and that they have more control over the results.

In any case, the developer must be contained in an iron dish lined with enamel, and must be heated by the aid of a spirit-lamp.

When the desired temperature is reached, a print is laid face downwards on the surface of the solution. If the temperature be high, development is almost instantaneous, but if it be low, say about 120° F., as long as fifteen or twenty seconds may be taken, and it is possible by lifting the print from the solution from time to time to observe the progress of the action, and if need be, to check it before it has gone quite as far as it will go. The developer may be used many times.

### *Fixing and Washing the Prints*

The object of fixing or clearing the prints is to get rid of all iron salts which, if they remained in the film, would produce yellow discoloration. The clearing solution consists of a mixture of 1 part of hydrochloric acid with 60 parts of water. There should be made up three baths of this mixture. The prints go from the developing bath directly into the first of these baths, where they remain for about five minutes, being afterwards passed through the second and third baths. After they have left the last, they are washed for a few minutes, when they are finished. As soon as the first bath becomes deeply tinted with yellow, and in any case when the last bath shows *any trace of yellowness*, No. 1 should be thrown away, No. 2 substituted for it, No. 3 for No. 2, and a fresh No. 3 bath should be made up.

The prints will be found to dry without any tendency to curl up.

### *Brown Tones in Platinotype*

The Platinotype Company sell a paper which gives a fine brown colour of image. As the writer does not know wherein consists the difference between this and the paper prepared according to Mr. Willis's patent, he can only advise those who give the paper a trial to adhere strictly to the directions issued with it.

### *Sensitising of Paper*

Pretty much the same may be said of sensitising of paper as of the production of brown-toned prints. The instructions received with the materials should be strictly adhered to. A word or two here may, however, not be out of place.

It is almost necessary to work by white light, as the yellow light from gas or oil lamp scarcely renders the yellow sensitive solution visible at all, so that by such light it is impossible to see whether the coating is even. The white light must, however, be *very* feeble compared with what may be used with sensitised - albumenised paper. This is for two reasons. The platinotype paper is considerably more sensitive than albumenised paper, but more than this, there is, in the case of platinotype, no action equivalent to the clearing action of the toning and fixing of albumenised paper, which will remove a slight tint existing before these processes are gone through. It is therefore necessary to be careful of light in a degree more than proportionate to the greater sensitiveness of the platinotype paper. Probably only about one-tenth as much light is permissible with platinotype as with albumenised paper.

For coating the paper a piece of soft sponge may be used or one of the damping brushes for copying - books made of felt or flannel. In any case it is necessary to wash the sponge or brush in clean water at the end, say, of every quarter of an hour, and if there is any metal mounting on the brush, care must be taken not to let it touch the sensitising solution.

The paper should be dried in a warm place (say near a coal or coke stove), where a thermometer will stand at from 80° to 95° F., and the time taken for drying should be about ten minutes.

### *Platinotype Prints on Linen and other Fabrics*

Platinotype prints may be produced on almost any white fabric which will stand treatment with weak acid, etc., and the effects produced on some of these are exceedingly good. Various fabrics are sold ready sensitised by the Platinotype Company, and linen, etc., may be sensitised in the same way as is paper.

## CHAPTER XXXII

### MOUNTING PRINTS

PERHAPS this is as good a place as another in which to give a description of the process of mounting prints. The descriptions of true photographic printing processes are over —of processes, that is, wherein impressions are singly got by exposing a sensitive film under a negative. Hereafter processes are to be described whereby great numbers of prints are produced in a printing-press, or machine of one kind or another; and the mounting of such prints—if they require to be mounted—comes rather within the sphere of operations of the bookbinder than of the photographer. No difficulty will be found, however, if it be at any time desired to mount a single print produced by mechanical means in using one of the methods to be described here.

#### *Mounting Albumenised Paper Prints, Platinotype Prints, etc., in the Ordinary Way*

Under the above heading comes the mounting of prints made by any of the processes which have already been described, except such as have been dried in optical contact with glass. These latter—for example, prints on "rapid paper," on gelatino-chloro-citrate paper, and Lambert-types—require to be treated in a somewhat special manner.

The favourite mountant amongst photographers appears to be starch. The writer prefers to use a thin glue made up of gelatine; but if the photographer prefers to use starch, he may use it in precisely the same manner as is to be described for the gelatine solution. The objections to the starch solution are, that if it get sour either before it is applied to the back of a silver print, or afterwards in the case of the print and mount being exposed to dampness, the permanency of the image is endangered; and further, that any spots or streaks of starch allowed to get on to the face of the print are more difficult to remove than similar spots or streaks of gelatine, and make much more conspicuous marks if left.

A gelatine solution is made up as follows:—

One ounce of hard gelatine is softened in 10 ounces of water, and heat is applied to melt it. This forms a glue which is of the consistency required.

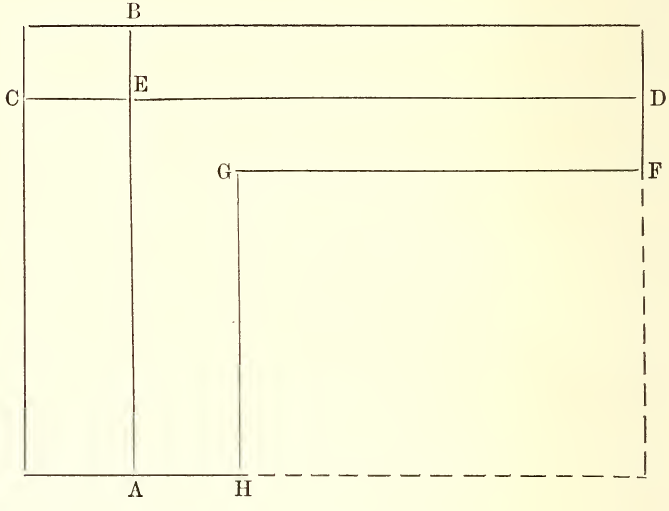
The method of mounting must vary a little when there is but a narrow margin, such as in the case of cartes and cabinets, from when there is a broad margin, such as is generally the case with landscapes. In the first case, the position of the print on the mount may readily be adjusted by the eye; in the second case, it is necessary to mark it.

Taking the case of the narrow margins first. The mounting solution is made very hot—not very far short of the boiling-point, in fact; if it be only slightly above its melting-point, it will set on the print before the position of this has been properly adjusted on the mount.

The back of a print is quickly brushed over with the mountant, and is placed on the mount. For a few seconds after it first touches the mount its position may be adjusted by sliding. Whenever it has taken the right position, it is covered with a piece of white blotting-paper, and the ball of the hand is pressed over this latter to squeeze out all excess of mountant, or by a few strokes of the squeegee the same is effected. In either case any excess which may have come from under the print, and which may lie on the face either of the print or of the mount, is immediately removed by lightly rubbing with a sponge dipped in clean hot water.

When prints are to be mounted with wide margins, it is necessary to mark the position to be occupied by two of the corners on the mount. When a number of prints of the same size are to be mounted on cards of the same size, a gauge for marking may be made in the following manner :—

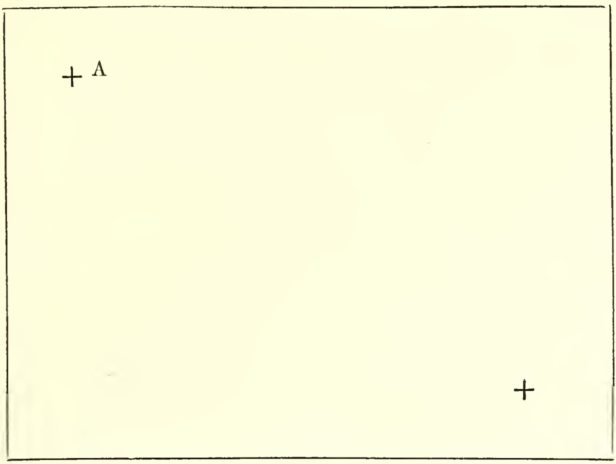
A sheet of smooth stiffish paper is cut to the size of the mount. Out of one corner of this is cut a piece the size of




the print. This leaves an L-shaped piece of paper. Each leg of this L is now folded longitudinally in half.

The figure will show the manner of cutting and folding. The dotted part represents that which is cut away. The lines A, B, and C, D are those along which the paper is folded. E, D, F, G, H, A is the shape of the figure that will be thus made.

To mark the mount the corner E of the gauge is placed at the upper left-hand corner of the mount, the lines E, D, E, A along the edges of the card. G is now the position to be occupied by the upper left-hand corner of the print. It is marked by a light dot. The lower right-hand corner is marked in a similar manner. It is well, after the points have been marked by the aid of the gauge, to mark a cross with a needle-point through each, so that the position of the point will be indicated even if the corner of the print cover it. The adjoining cut, in which A and B are the two needle-point crosses, will explain what is meant.




When, as is very often the case, there is a number of prints of various sizes, which have to be mounted on boards all of the same or of various sizes, there is nothing to be done but to mark each board separately by hand. This is a thing that can very easily be done by the aid of a T-square. A needle-holder, such as is frequently included in a set of mathematical instruments, is a very convenient thing to have for marking the boards.

The boards having all been marked, a print is brushed on the back with glue as described, is taken by the right-hand top corner and the left-hand bottom corner, and is lowered towards the mount. The paper is allowed to bag or sag somewhat downwards, when the two free corners can be brought just to the two marks on the board. The two corners held in the hand are now allowed to drop. It will of course be perceived that if two of the corners be properly adjusted, the other two are bound also to be in the right position.

The excess of glue is now squeezed from between the print and the mount, and is washed away as already described.

If this process is very quickly performed, so that the print has barely time to get wet through, the cockling of the mounts will be but small. If, however, any considerable time elapse between the time of gluing the print and adjusting it to the mount, the cockling will be considerable.

It is likely that some may prefer to apply the glue to the mount rather than to the print, damping the print, and submitting to the cockling of the mount, which may be removed by subsequent rolling or burnishing. This method of mounting is the easiest of any, but has the disadvantage that, on account of the unequal expansion of the paper (greater in one direction than in another), a slight amount of distortion is brought about which may be appreciable.

To mount after this manner, the prints are placed in a dish of hot water, the mount is brushed thickly over with the gelatine solution, the print is applied, the excess of gelatine is removed by the application of the squeegee direct to the print, and the edges are wiped clean with a sponge.

Various alcoholic and other mountants which do not cockle prints at all are sold, and some of them are excellent. For a time a solution of rubber in benzine was very popular. It is very convenient. The mount and the print are simply covered with the solution, and the two surfaces are brought into contact after the benzine has partially evaporated, when they adhere. There is no cockling, and the operations are very simple; but I believe it has been found that after a time the rubber "perishes" and the prints strip from the mounts.

The alcoholic solutions have not the objection mentioned, and are to be highly recommended for small work. There is difficulty in using them for large work, as they set very rapidly when cool. This tendency can generally be overcome by adding water to them, but then the "non-cockling" properties are lost in part or altogether.

A good alcoholic mountant may be made as follows:—

An ounce and a half of gelatine is soaked in 4 ounces of water till it is soft, when it is melted by the aid of heat; $\frac{1}{2}$ ounce of glycerine is added, and then 10 ounces of strong methylated spirit, the last-mentioned being added at two or three operations.

### *Dry Mounting*

This is a term generally applied to a method of mounting introduced by A. Cowan, in which the print is applied with a dry mountant to a wet board.

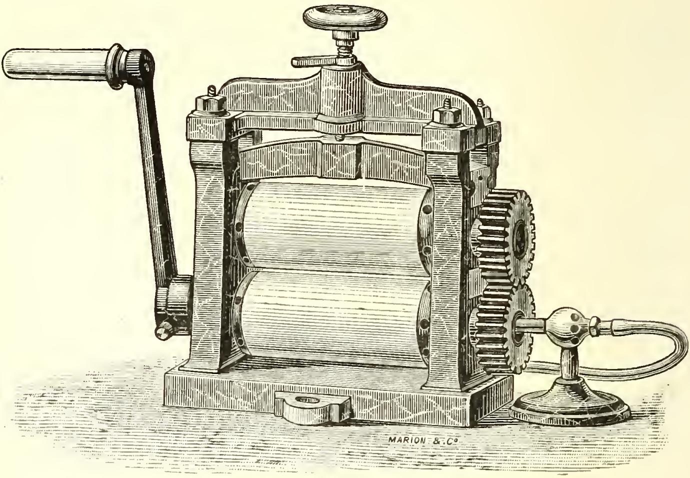
The prints as they come from the washing water are laid face downwards in a pile on a large plate of glass. A solution of starch, such as would be pretty thick if cold, is made up, and some of this is brushed with a stiff brush on to the back of the topmost print. This print is now laid on one side face downwards to dry, when another is treated in a similar manner. These prints will dry with scarcely any perceptible curling or cockling.

In mounting a card is damped, the print is brought into contact with it, and the two together are passed between the rolls of a rolling machine, when they will be found to adhere, and there will be no trouble in the way of bending or cockling of the mount.

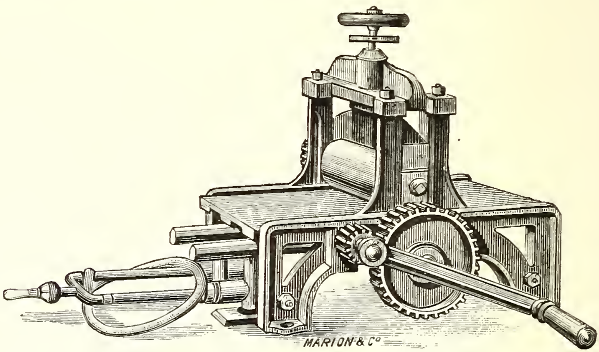
### *Rolling and Burnishing Prints*

Almost every kind of print mounted as has been described is improved by rolling, whilst albumenised prints are greatly improved—or at any rate receive a gloss which some consider a great improvement—by passing them through a burnisher.

Rolling machines consist either of two rollers or a roller and a plate. The former form of machine is commonly used for small sizes, the latter for large. To give the best effect the plate or one of the rollers is heated. Rolling machines are generally provided with arrangements for heating the part with gas or otherwise. In rolling pigment prints or any into which gelatine enters as a com-

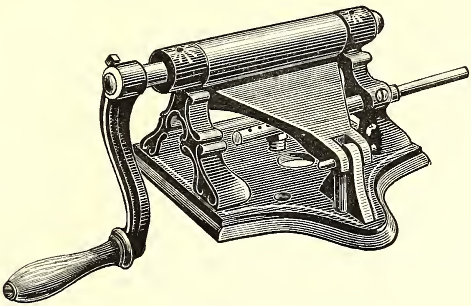



ponent, great care must be taken to have the image very dry before it is allowed to touch the hot surface. In fact,




it is well to dry it in front of a brisk fire before letting it pass through the machine.

Burnishing differs from rolling in that in the former the surface of the print is *rubbed* against a polished surface in place of being rolled between two such surfaces. The burnisher is always used hot. It is as a rule applied only to prints on albumenised paper. The burnisher is heated with gas or a spirit-lamp. The gloss obtained is higher than with a roller, but more skill is required in working.



The prints before they are burnished should be rubbed over with a solution of 3 or 4 grains of Castile soap in an ounce of methylated spirit, a piece of flannel being used. They lie till they are quite dry, and are then passed several times through the machine, enough pressure being put on to pinch the card pretty tightly. If the surface of the prints tears, it shows (1) that the surface of the burnisher is out of order; (2) that too much heat has been applied; (3) that too much pressure has been applied; or (4) that the soap has not been properly spread over the face of the print.

Any fault in the burnisher will readily be recognised by the fact that scratches or marks of tearing repeat themselves in the same places on print after print. The burnisher may be repolished by applying an oil-stone to it.

If the burnisher do not give a sufficient gloss, it is because three is too little pressure, or the heat is not sufficient. If the surface of the burnisher is in good order, a very considerable heat—just such as will not scorch the paper—may be used, and so much pressure that it is fairly hard work to turn the handle. Burnishing in this way gives a *very* high surface, and generally improves the tone of the print considerably, making it a good deal warmer than it was.

### *Encaustic Paste*

The object of the use of encaustic paste is to give a surface something like that given by the burnisher. Its use has greatly gone out of fashion lately, probably because the use of the burnisher has superseded it. It may, however, be found very useful, and especially to those amateurs who do not possess a burnisher. The process consists in covering the surface of the print with a thin film of wax. The famous photographer, Adam Salomon, was the first to popularise the use of encaustic paste, and I therefore give precedence to his formula, although it seems in practice to give results little if at all better than the very simple one that follows it:—

| | | |
|---|---|---|
| Pure white wax . . . | 1 | ounce |
| Gum elemi . . . . | 10 | grains |
| Benzine . . . . . | ½ | ounce |
| Essence of lavender . . . | ¾ | " |
| Oil of spike . . . . | 1 | dram |

These ingredients are mixed by the aid of heat. The second formula is—

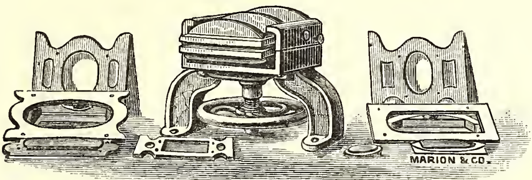
| | | |
|---|---|---|
| White wax . . . . | 1 | ounce |
| Spirits of turpentine . . . | 1 | " |

A little of the encaustic paste or waxing solution is taken up on a piece of flannel, and is rubbed over the surface of the print, which is then polished with a second clean piece of flannel till it assumes a burnished appearance.

### *Mounting Prints that have been Dried in Optical Contact with Glass*

Those who have read the description of the "rapid printing" process, of the process of printing on gelatino-citro-chloride paper, and of the Lambert-type process will remember that it is advised, in the case of each of them, to dry the prints in optical contact with glass. If this be done, there are objections to mounting the prints in the usual way, as a great part of the gloss obtained by the particular manner of drying is thereby lost. It is true that if one of the alcoholic mountants already mentioned be skilfully used, the loss of brilliancy is but slight; still if it be desired to keep the full gloss, it will be well to have recourse to a special method of mounting.

When the prints can be mounted behind cut-out mounts there is a very simple method of proceeding. A little margin is allowed in printing, and the print is fixed to the mount by this margin only, which is afterwards hid




by the cut-out mount. The effect is greatly increased if the print is *embossed*, the space behind the embossing being filled with a little cotton-wool to prevent the print from flattening out again. The embossing is done by the aid of a special press such as is illustrated here. It can be fitted with dies of various shapes and sizes to suit different subjects.

The best way in which to mount prints, such as those at present under consideration, is, however, to fix the mounts to the prints whilst the latter are still damp on the glass. If the actual mount be thin, it itself may be fixed to the print. The print is allowed to dry till it is no longer wet but only damp. It is then brushed over on the back with a mounting solution made of gelatine, the card is quickly applied, and the two are kept in close contact by pressure for an hour or so, after which they are laid on one side till the print has dried through the card, a process of course taking time. This method is troublesome in various ways, and a better method of proceeding is as follows :—

A little margin is allowed the prints before they go through the various processes up to that of mounting. Very thin cardboard of good quality is cut to a size a trifle smaller than the prints. These latter are now as before allowed to dry till they are merely damp. One of these very thin cards is now brushed over with pretty thick mounting solution, and is applied to the back of a print. It is kept in close contact by being placed under pressure for an hour, and is then allowed to dry. The two leave the glass together, are trimmed together, and are mounted together on any kind of mount by being fixed to it with stiff glue round the edges. The thickness of the cardboard in this case prevents the dampness of the glue from hurting the surface.

### *Enamelling Prints*

Prints such as those just treated of,—that is to say, those dried in optical contact with glass, are said to have an "enamelled" surface. It is not at all difficult to treat prints on albumenised paper in such a way that a similar effect is produced. All that is necessary is in fact to dry such prints in optical contact with glass when the desired result is produced, and the writer has enamelled prints by the simple process of rubbing French chalk over the surface of a plate of glass and squeegeeing a wet print on to it; but this is a very uncertain process, the print commonly either leaving the glass before it is dry or refusing to leave it when it is. The following is a very satisfactory method to use :—

Plates of glass a little larger than the prints are cleaned and are polished with French chalk. They are then coated with plain collodion (a special cheap collodion sold as enamel collodion is particularly suitable), the plates are washed till all apparent greasiness has disappeared, and then the print is squeegeed wet on to it. The print readily strips off when dry.

Another method which some prefer is as follows :—The plates are coated with collodion as described; but in place of being washed are allowed to dry. The prints are placed in hot water. A plate is carefully levelled collodionised side upwards, and a warm solution of gelatine, 20 grains to the ounce, is poured over it. A print is taken from the warm water and is laid face downwards on the gelatine, care being taken to enclose no air bubbles between the two surfaces. The excess of gelatine is squeegeed away, and the plate is set on one side to dry.

It will be understood that if it be desired to mount such prints, they must be mounted in the manner already described for other prints, which are dried in optical contact with glass.

### *Mounting Prints in Optical Contact with Glass for Rims, etc.*

This is a method of mounting which is very popular with some. It has the effect of giving a print on albumenised paper, or with a gelatine surface, a wonderful brilliancy and transparency of shadow. The process will very readily be understood if I say that, in any of the cases just described, where prints are *dried* in optical contact with glass, if special care be taken to *prevent* the print from stripping when dry, the desired result will be got. Then the French chalk and the collodion are left out in the case of prints on albumenised paper, the clean glass being simply floated with gelatine, the print being taken from hot water, placed on to the gelatine, squeegeed down, and set on one side to dry. If prints on rapid paper and on gelatino-chloro-citrate paper be mounted on glass, simply omitting the French chalking, they will probably adhere, but there can be no certainty of this as the aluming gives a surface which does not adhere very readily to glass. If, therefore, it be desired that they remain in contact with the glass, they should be cemented down with gelatine solution as described for albumenised paper.

A very effective positive on glass is made by developing a carbon image on plain glass by single transfer, as for a transparency, but giving less exposure, and backing the image with white paper by flowing it with gelatine solution, and bringing the paper into contact with it.

It is to be observed that if the best results be desired patent plate should be used, that brown tones generally give the most pleasing results in optical contact with glass, and that the best style of framing is a narrow rim of metal or of wood coming right up to the edge of the print.

# PHOTO-MECHANICAL PRINTING PROCESSES

## *Preliminary Note*

A reference to the second chapter of this book, in which is given a brief sketch of the best known photo-mechanical processes, will show that the number is very great, and it will at once be seen that to give practical working instructions for all these would involve a work of great length, even were it possible to give such instructions; but it is not possible as, in the case of many of the processes, the leading principles only have been published, the details of working have not, and to investigate them all would take more time than any one writer could give to the subject.

It is possible, however, to describe a series of typical processes, to one or other of which all photo-mechanical processes are more or less allied, and the thorough study of which by any one wishing to take up the working of any photo-mechanical process, should so far qualify him that nothing but intelligent application is further necessary to him. The Woodbury process is placed first because, as has already been said, it is the only true half-tone process, and because it forms the master-key for various other processes, of which the first step is the production of a Woodbury relief.

## CHAPTER XXXIII

### PHOTO-MECHANICAL PRINTING PROCESSES

#### *The Woodbury-type Process*

*Preliminary Remarks.*—A little consideration of the carbon pigment process will show that an impression consists not only of various tints or gradations of pigment, but also of various amounts of relief, and that if this relief were to be obtained in any way, such as by casting the pigmented jelly in a mould, the gradation of tint or colour would follow as a consequence. A little further consideration will show that, inasmuch as the carbon image itself has relief, it might be made the means of producing a mould, were it first of all reproduced in negative; and in fact the first attempts of Woodbury in working out his process consisted in taking negative reliefs from carbon prints by electro-deposition of copper. The process thus worked gave, however, no very satisfactory results, and it was not till Woodbury discovered that the hardness of a dry gelatine image is such that it can actually be pressed into lead that his efforts met with success, the impression in lead of course forming a mould in which an image might be cast in pigmented gelatine.

A difficulty is, however, that the image in drying shrinks so that its relief becomes only a fraction of what it is when it is wet. For this reason some steps must be taken to secure a great initial relief. This is done by having a very thick film of bichromated gelatine with but little pigment in it, so that the light may readily penetrate it.

When the Woodbury-type process was first worked, the difficulty in getting a sufficiently high relief was much felt. At that time paper was not to be had nearly as smooth as it can now be obtained, and with a comparatively slight relief faults in the paper showed very plainly. It is now, however, possible to work with a relief in the final print of only $\frac{1}{2000}$ of an inch or even less, and as the relief of the print shrinks in drying by about ten times, this involves in the mould a relief of only about $\frac{1}{200}$ of an inch,[1] which is one that is not difficult to get if due precautions be taken. It will be evident that it is necessary to begin upon a film at least as thick as the relief required, and that initial thickness of film being sufficient, the depth or height of relief will be greater the greater the contrast in the negative, and the less the amount of pigment in the film. Indeed the pigment may be left out altogether when a negative of only moderate density *has* to be worked with. From a "thin" negative no tolerable Woodbury-type need be expected. If it is necessary to work from such, a negative of great contrast must be got by taking a transparency from the thin negative on a slow plate, intensifying it, taking a negative from it, and if necessary intensifying this latter also.

I shall suppose that a negative well suited to Woodbury-type work has been selected,—that is to say, one in which the gradation is good, but in which the extreme contrast between high light and shadow is somewhat more than would be considered desirable for the production of a silver print.

### *Preparing the Sensitive Tissue*

The following formula, which is taken from the *Photographic News*, will be found to give satisfactory results :—

| | |
|---|---|
| Nelson's transparent sheet gelatine . | $3\frac{1}{2}$ ounces |
| Sugar . . . . . . . | 1 ounce |
| Glycerine . . . . . | 100 grains |

---

[1] *Photographic News*, September 14, 1883.

| | |
|---|---|
| Phenol . . . . . . . | 2 minims |
| Indian ink . . . . . . | 2 grains |
| Ammonia (strongest) . . . . | 60 minims |
| Bichromate of ammonium . . . | 300 grains |
| Water . . . . . . . | 12 ounces |

The gelatine is set to soak in about 10 ounces of the water. The Indian ink is dissolved in the remainder.

The gelatine being thoroughly soaked is melted by the aid of heat, and to the solution are added the sugar, glycerine, phenol, and ammonia. The Indian ink and water are then added, and lastly, the bichromate of ammonium is stirred in, in a fine state of powder. Sheets of patent plate of the size of print desired, or rather larger, are prepared by thoroughly cleaning them, rubbing one side with French chalk, and coating it with a film of plain collodion, which is allowed to dry spontaneously.

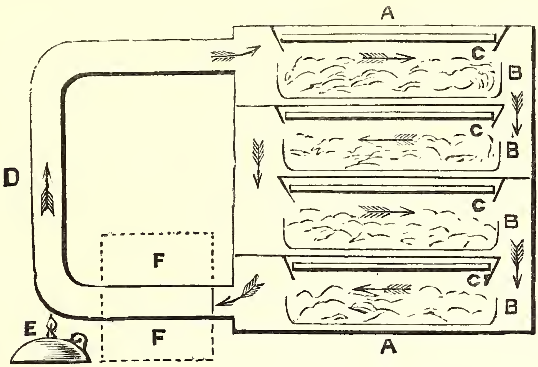
The plates and the solution being now ready, the former are warmed and are carefully levelled, the latter is raised to a temperature of about 140° F., and a measured quantity is poured on to each plate, and is carefully spread over it. About $\frac{1}{2}$ ounce for each quarter plate ($4\frac{1}{4} \times 3\frac{1}{4}$) will be found right, say 5 ounces per square foot.

This film is comparatively very thick, and some special means have to be taken to dry it rapidly, otherwise it would be spoiled before the water was driven from it. The method used in drying Woodbury-type films is always one in which slightly heated air is caused to circulate first over dried chloride of calcium, then over the films. The chloride of calcium absorbs all (or practically all) the water from the air, which then very greedily absorbs the water in the films.

Various forms of drying box have been designed for effecting the desired end. The illustration we give is taken from the *Photographic News*. It shows a box which will answer the purpose as well as any other.

The films are ready to be placed in the box whenever the gelatine has set. I should have mentioned that all operations up to the point where the films are dry may be carried on in moderate daylight; when they are dry, they must be at least as carefully guarded from light as a sheet of sensitised-albumenised paper is.

The chloride of calcium is used in small fragments, which should be dried just before they are required by heating them over a bright fire in an iron sand-pan or on




a shovel. The same chloride of calcium will serve an indefinite number of times if it be always dried before it is used. A thermometer should be used and the temperature should be raised to about 80° F.; but should never, on any account, be allowed to exceed 85°.

When the films are dry, they are separated from the glass by the aid of a penknife. They are best used at once, or within a day or two at the outside. Till they are put in the printing-frames, they must be carefully protected from damp by wrapping them up in tinfoil.

## *The Exposure*

The quality of negative suitable for use to produce a Woodbury-type relief has already been described. It should have a "safe edge" run round it as in the case of carbon printing.

The film is placed in the frame collodionised side next the negative, and a piece of tinfoil or a plate of glass is placed on the back of it to protect it from moisture. For the means of determining the length of exposure, I must refer the operator to the chapters on carbon printing. An actinometer must be used with the Woodbury tissue as with carbon tissue, but the exposure must be somewhat longer, even after allowing for the unusually dense negative that is recommended. It is, however, rather an advantage than otherwise to print in full sunshine, the plane of the negative being kept at right angles to the direction of the sun's rays; in such a case the exposure need not be very protracted. The image is visible if but little or no pigment be used, but it is not advisable to open the frame to examine it, lest the tissue be attacked by damp, which may have the effect of rendering it insoluble even in hot water, and therefore undevelopable.

### *Development of the Image*

The exposure over the film is ready for development, which is performed in the same way as that of a carbon print, but takes a much longer time on account of the excessive thickness of the film. It is necessary to attach the tissue to some rigid support during development, to prevent it from collapsing altogether. There is nothing better for a support than glass, and no better substance for fixing the tissue to the glass than rubber dissolved in benzine. The thick rubber solution, which is sold in tins, may be used, being thinned down with benzine or benzole, so that it will flow like collodion. The benzine should be as pure as it can be procured. Gum, or, if it be preferred, para, which is a very pure form of rubber, may be dissolved in benzole in such quantity—perhaps about 5 grains to the ounce—as will result in a liquid of the consistency mentioned.

Glass plates are flowed with the solution as with collodion, but as little excess is poured off as possible, the plates being levelled till the rubber has set or assumed a "tacking" consistency, which may take an hour or two. A film is now brought into contact with a rubber-coated plate by bringing the collodion side of the former into contact with the latter, care being taken to avoid air bubbles by bringing one edge of the film first in contact with the plate if the size be small, a line from one corner to another opposite if it be large. Pressure is now exerted to bring about close contact. If a rolling machine with rubber rollers be at hand, such as an ordinary wringing machine, it may be used, or a machine with metal rollers may be used by placing a thick sheet of rubber below the plate and another over the image to prevent breakage.

The development is performed solely with hot water, and must proceed spontaneously, patience being the great thing necessary. Some means must be arranged for keeping the plate under water in a vertical plane. Nothing is better for this than a metal-grooved box, in which a number of plates can be developed at one time. At first the temperature should not exceed 110° F., or, perhaps still better, 105°, and the water should be changed frequently. When the bichromate salts have all been dissolved away, the water coming off quite colourless, the temperature may be raised till eventually it reaches as high perhaps as 150°, or even 160°. As already stated, time must be allowed, the development is seldom complete in less than two hours, and may take as long as two days. The progress of the action may be observed from time to time by removing the glass bearing the image from the water. It will be readily enough seen if there be pigment in the film, as the image should then appear as a perfect transparency. If there be none, the effect is best judged of by passing the finger over the film, when the relief can be judged of. A relief without pigment has by no means a very promising appearance, but this need by no means discourage the operator.

Development should be continued when the parts of the film representing the high lights are dissolved away all but to the collodion. By this time, if the exposure have been right, the whole of the surface should be covered with modelling, but the highest relief should still represent the whole thickness of the film or nearly this,—that is to say, but little gelatine should have been washed from the parts which represent the shadows of the print. If the exposure has been too long, great parts of the film will show the original surface, no gelatine having been washed from it at all, and prints with heavy dark shadows will result. If, on the other hand, the exposure has been too short, the whole thickness of the film will be so reduced that the relief will be but slight, and only weak, poor prints can be expected. Probably over-exposure might be compensated for to a certain extent by adding a little ammonia to the developing water, as is sometimes done in the case of over-exposed carbon prints.

When it is judged that development is complete, the plate is rinsed for a few minutes in a stream of cold water. It is then placed for ten minutes in a 4 per cent solution of chrome alum to render it as little likely to be subsequently attacked by moisture as possible. It is then once more washed in cold, or tepid, water to get rid of the chrome alum, is allowed to drain till it has become surface-dry—till all drops of moisture have run from it that is to say—and is placed in a dish of methylated spirits to remain there for an hour. It is then allowed to dry like a dry-plate negative.

When the film is quite dry, it is removed from the glass by inserting the point of a penknife under one corner and gently dragging it away. The rubber comes with it, but may be removed by laying the film on a flat surface and rubbing with the tips of the fingers. The rubber is thus *rolled* off in little balls. Any pin-holes in the negative or accidental marks which would print *dark* in the final print will show as projections on the gelatine relief, and may be removed by a strip of glass broken square across. A skilful Woodbury printer may, in this way, do much to improve a relief, but the beginner should confine himself to the removal of such sharp projections as will result, if left, in small dark spots.

The relief having reached the stage indicated is ready to be used for the production of moulds in lead; but "it is not desirable to make immediate use of the relief, as it continues to contract slowly for some hours after its removal from the glass plate; and until it has attained its normal condition of equilibrium, it is liable to break up under the influence of pressure."

The most convenient method of storing away the reliefs is to make up books out of envelopes; the open sides of the envelopes being directed inwards towards the back of the book. This arrangement affords great facilities for indexing the subject.[1]

### *Production of Lead Moulds from Woodbury Reliefs*

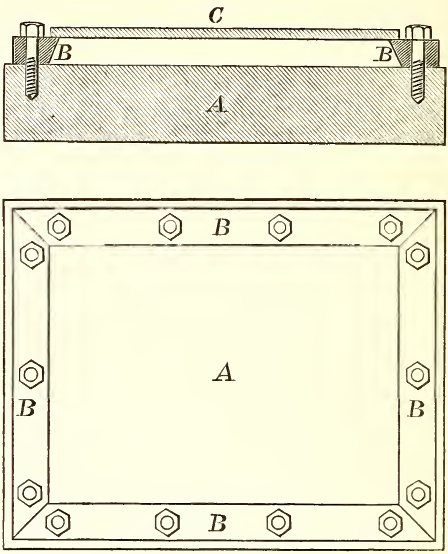
For the production of lead moulds from Woodbury reliefs all that is necessary is a machine for pressing the relief down on to the lead with sufficient pressure to drive the hard gelatine into the substance of the metal. But this "all" is something very considerable, as the pressure required is much greater than might be imagined—is, in fact, something enormous. It requires a pressure of nearly 4 tons per square inch of the surface of the relief,—that is to say, about 50 tons for a quarter plate, 200 tons for a whole plate; the latter size being about the largest commonly worked, chiefly on account of the great pressures required for larger sizes.

Fortunately the manufacture of hydraulic presses for giving great pressures has now been brought to great perfection; the presses, moreover, being remarkably compact, and, considering the very great pressures given by them, very light. The length of stroke required for producing Woodbury moulds is also, fortunately, very small. A press, to give the greater of the two pressures mentioned (200 tons), may be purchased from Tangye Brothers, of Queen Victoria Street, London, for about £50.

In addition to the press, a plate of steel is required to receive the relief. This may, with advantage, be an inch thick, or nearly so, and must be planed and scraped up as true as a surface-plate on its upper side. It has then fixed to it bars of steel, to prevent the lead from spreading at

[1] *Photographic News*, March 21, 1884.

the edges when the pressure comes down; the bars enclosing a sort of trough a little larger than the relief. The annexed cut will serve to illustrate the matter. A is the steel plate, B, B, B, B are the steel bars, which may be $\frac{1}{2} \times \frac{3}{8}$ inch in section, slightly bevelled away at the inner edge as shown. They are fixed with set screws. C is the




lead plate, polished on its lower side, and smooth on both sides. The platen of the machine is made just to fit within the bars B, B, B, B, so that when it comes down it cuts off the edges of the lead plates.

The relief is placed on the plate A, the lead plate is placed in position as shown, one or more thicknesses of millboard are placed on the top of it, the platen is brought down with full pressure, and when it has been raised and the lead is removed, it will be found that a perfect mould has been produced, and then may be multiplied almost indefinitely.

The best moulds are produced when the relief is laid with the collodionised side next to the steel plate; but if all the steps of the process be followed, it will be seen that the result is a reversed print. If this be objectionable two courses may be followed. In the first instance a reversed negative may be produced. As the ordinary run of negatives are too thin for good Woodbury-type work, and as it would be objectionable to intensify them, thereby destroying them for ordinary work, it is very often advisable to reproduce the negative, getting one showing greater contrast than the original as already described. If this be done, the opportunity should always be taken to reverse the reproduced negative, by taking either the transparency from the original negative or the reproduced negative from the transparency in the camera; whichever is done, the plate photographed *from* being turned with its film away from the camera.

If this be not done, the relief must be laid on the steel plate, with the collodion side uppermost, and the first few moulds must be rejected. Those following will be to all intents as sharp as if produced with the collodionised side downwards.

The printing from a Woodbury mould is performed in the same way as that from a Stannotype relief, and is described in the next chapter, which treats of the latter process.

# CHAPTER XXXIV

## PHOTO-MECHANICAL PRINTING PROCESSES—*Continued*

### *Stannotype*

*General Principles.*—The reader of the last chapter will have perceived that the necessity for a hydraulic press in working the Woodbury-type process is quite enough to prevent it from becoming popular, in the sense of being worked by a number of photographers producing only on a small scale, or by amateurs. The object of the invention of the Stannotype process (also by Woodbury) was to do away with the necessity for the press.

A consideration of the principles of the Woodbury process will make it evident that were the gelatine relief produced from a positive, in place of from a negative, and could this relief itself be used as a mould for the direct production of prints, nothing further would be required. Now the only objection to the use of the gelatine relief itself as a mould is that the direct contact of the ink or pigment used in printing—which consists merely of gelatine and colouring matter in water—would destroy it, by reason of wetting it. This difficulty was overcome by Woodbury by the expedient, which appears as one that would be adopted as a matter of course *after* it has been explained, of protecting the relief by a sheet of tinfoil pressed into close contact with it.

### *The Transparency*

As has already been said, the relief to be printed from direct must be produced from a transparency, or dia-positive, in place of from a negative. This transparency may be made by any of the well-known processes for making transparencies. The same characteristics are required as for a negative for the Woodbury-type process—namely, a great range of density. Moreover, if a reversed print be not admissible, the transparency must be reversed. It must therefore, unless the negative is a reversed one, be prepared in the camera, or by single transfer in carbon. The last-mentioned process is the most commonly used—a carbon transparency being produced and being intensified with permanganate of potash, as already described in the chapters on carbon printing. Probably gelatino-chloride plates would give very good results.

In whatever way the transparency is produced, it is necessary that it should have an edging of clear glass, and also that the highest lights should be quite clear. The edging may be $\frac{1}{8}$ to $\frac{3}{16}$ inch in width. If the high lights be not quite clear, the high lights of the final prints will not be clear either; or, to speak more precisely, if the high lights be not as transparent as the edging, they will not print white. If *both* have a slight tint of the same depth no ill will result.

### *The Relief or Mould*

A suitable transparency having been produced, a relief is made from it in precisely the same manner as that described for the production of a Woodbury-type relief. I should perhaps, however, explain that the method described for making the tissue or sensitive film is only one of many that are in use. For example, the film may be first dried without the addition of bichromate, which may be afterwards added by sensitising in a 6 per cent solution of that salt. The tissue may be prepared by thoroughly wetting a piece of paper, laying it on glass, running the gelatinous solution on the paper, stripping the two together from the glass, hanging them up to dry in an ordinary room, and afterwards sensitising. I believe Woodbury himself used shallow glass dishes which he slightly greased, into which he ran the gelatine solution. He allowed this to dry, then brought a piece of damp paper into contact with the upper surface. The paper adhered, the thick film of gelatine was drawn by it from the mould, the paper quickly dried, when the resulting tissue was sensitised in a solution of bichromate of potash and dried.

Of course, when paper is used as a support, the side remote from the paper is brought into contact with the negative, that side is afterwards attached to glass either by india-rubber solution, as already described, or by coating the glass with gelatine containing a very small quantity of bichromate in solution and drying the film in sunlight. In the latter case the tissue is attached to the coated plate by bringing the surface of the former and the coated surface of the latter into contact under water, removing them together, and leaving them for some time under pressure. These operations will be found fully explained in the chapters on the carbon process.

When paper is used as a support, it will, of course, detach itself from the tissue as soon as development begins.

The tissue having been prepared by any of the methods described, exposed, developed, and dried, is allowed to remain on the glass plate, which should be thick and quite flat.

It is now only necessary to coat the surface with tinfoil when the mould is ready to be printed from.

If only a few impressions—say a hundred or two—are required, ordinary tinfoil will serve the purpose; but if a great number be needed, steel-faced foil made specially for Stannotype work should be used.

A piece of the foil a little larger than the relief is examined by holding it in front of a light to see if there are any pin-holes. If there are any it must be rejected, as the smallest pin-hole would allow the gelatine under the tissue to get wet, and would, if it led to no worse result, produce a white spot on each print from the swelling of the gelatine.

The tinfoil is laid out on a piece of glass, and is flattened with a velvet hat-brush or a piece of velvet stretched over the ball of the thumb. The relief is then prepared in the following way:—The edging, which is in high relief, is coated with a thick solution of rubber in benzine or in chloroform. When this is set, the whole surface is flowed with a thin solution of rubber, in the manner usual with collodion. The best rubber to use is gum para, and a good strength of solution is 2 grains to the ounce. *Pure* benzine will do very well as a solvent, but chloroform is preferred by some.[1]

Whenever this film has set the sheet of tinfoil is brought carefully down on to the surface of the rubber, it is smoothed into rough contact with the velvet brush, and then is brought into intimate contact by passing the plate bearing the mould and the tinfoil sheet between two rubber rolls, the ordinary domestic wringing machine serving every purpose. The rolls are opened, the plate is inserted, and the rolls are closed across the middle of it. They are then worked first one way then the other for two or three times, when the mould may be looked upon as complete. Before printing from it, it is carefully oiled with a rag dipped in olive oil, which has been thinned down by the addition of about an equal quantity of thin paraffin oil.

### *Printing from Woodbury and Stannotype Reliefs*

As has already been said, the process of printing from a relief is in fact a process of casting. Into the relief or mould a certan portion of a solution of gelatine and pigment is poured, paper is placed over this, by pressure the excess of pigmented gelatine solution is squeezed out, and what remains is allowed to set. It adheres to the paper and comes out a perfect *casting* of the mould, showing relief, and, as a secondary consequence of this relief, *gradation* of colour.

The first essential for printing from reliefs is a suitable

[1] See an excellent series of articles on Stannotype running through the *British Journal of Photography* for 1884.

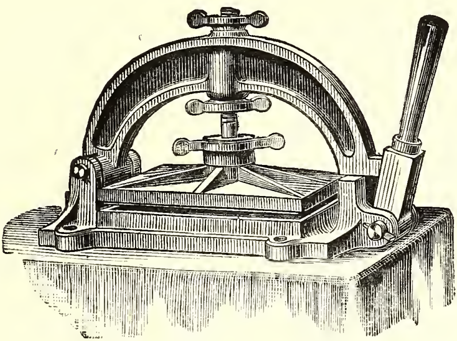
paper, one that is with a perfectly smooth surface. To begin with, a good paper of even texture is selected, such as Rines's photographic paper. This is then treated with a "lac" or sort of varnish which is made up as follows:— "4 ounces of borax and an ounce of carbonate of soda are dissolved in 3 pints of water. The solution is heated to the boiling-point, and a pound of white shellac is added, the boiling being continued till the whole is dissolved. When cold, the liquor is made up to its original volume, and a little carmine is added to give it a faint tint; this being an advantage, as it renders it easy to distinguish the coated side of the paper." The coating is then performed in the following manner:—

"The room in which the coating of the paper is carried on should be kept warm; it is not desirable that the temperature fall below 90° F. The solution is filtered into a tolerably deep dish, this being inclined a little so as to give an increased depth of liquid in that part of the dish next the front edge of the table. Two sheets of paper are now taken and are held by opposite corners, so as to keep two edges in close contact, and this double edge is quickly immersed in the shallow part of the dish, after which the two sheets are rapidly drawn forward and brought out of the solution at the deep edge of the dish. The sheets adhere at the edges, but the liquid does not penetrate more than an eighth of an inch from the borders. The double sheets are now pinned up to dry, when they are separated, the most convenient course being to cut off a slip one-eighth of an inch from one edge and then to use a paper-knife. . . . Still another coating is required. . . . A kind of emulsion of gelatine and resinous matter is made by dissolving 1 part of gum benzine in 10 parts of alcohol. After the solution has been filtered, it is mixed with a warm solution of 1 part of gelatine and 9 parts of water, care being taken that violent agitation accompanies the mixing. The milky fluid is applied to the surface of the lac-coated paper by means of a soft cloth, it being sufficient to thoroughly moisten the surface."[1]

[1] *Photographic News*, April 10, 1884.

The paper after it has dried requires now to be carefully rolled by passing a set of alternate sheets of paper and thin polished steel plates through a powerful rolling press. The paper, after it has been prepared as described, must be handled with the greatest care, as the smallest roughness produced by crumpling it will show as a blemish in the finished print.

The next necessity for printing is a press. This is a comparatively simple piece of machinery. In fact, any press working with a platen which will give a moderate pressure,



is applicable for Woodbury printing, but the press specially designed for the work and illustrated here will be found the most convenient.

It will be seen that the press has something of the form of an ordinary letter copying press, but that the bow or arch is hinged at one end, so that it, with the platen, can be raised up. There are also three nuts on the screw. The object of these three nuts is to obtain (1) adjustment of distance between the bed of the press and the platen—in which latter is inserted a thick sheet of plate glass—for different thicknesses of mould; (2) adjustment of angle of the platen in case of want of parallelism between the two faces of the mould; and (3) adjustment of pressure to a desired amount, which can then be repeated by simply lowering the arch.

The mould is placed on the bed of the press, a piece of wet cardboard being placed under it to prevent breakage if it be a Stannotype mould. The three screws are loosened and the platen is allowed to come down on the relief. The screw immediately below the arch is now screwed upwards with some force. This applies the pressure. The top screw is now tightly screwed down. This connects the screw rigidly with the arch of the press. The lower screw, which clamps the ball-and-socket-joint connecting the screw with the platen, is now firmly turned home, when the platen is found to be rigidly connected with the arch, so that it will always come down with the latter to precisely the same position.

The ink or pigment has next to be considered. This is, as has already been said, simply gelatine, water, and colouring matter. A hard gelatine should be selected. Heinrich's gelatine for emulsion work will be found very suitable, and 1 part of this is dissolved in 5 parts of water. The amount of colouring matter required can only be discovered by experiment as it varies with the depth of the mould, being *less* the deeper the mould. As a rule Indian ink forms the body of the colour, and tone is given with carmine or some such colour. To save the trouble of grinding the ink, the liquid form sold by colourmen may be used, or "colour for carbon printing" may be obtained ready mixed to the required tint and tone from Newman, 24 Soho Square, London, W. A first trial may be made with so little colour in the ink that a drop of the compound on a sheet of glass is still somewhat transparent.

George Smith, who is an authority on Woodbury-type printing, uses, for producing lantern slides by the process, a "lamp-brown," got by collecting the smoke from the tip of the flame of a small lamp burning benzine. The colour is very rich, and has the advantage of undoubted permanence, whereas, if carmine be used to give tone to lamp-black, the redness of the colour may fade through time, leaving black only. He also adds a little bichloride of mercury to the ink which prevents the gelatine from decomposing or becoming mouldy.

The jelly, consisting of 1 part gelatine, 5 parts water, will work well in summer, but may be found too stiff in winter. In this case more water is added and also more pigment.

All being now ready for printing, and the mould having been oiled with the oily cloth already mentioned, the arch and platen of the press are lifted, enough ink is poured into the mould to form a pool of about half the diameter of the picture, a sheet of paper is carefully laid on it, somewhat as a sheet of albumenised paper is laid on the silver bath, the platen is brought down, and the whole is left for a few minutes to allow the gelatine to melt. The print is then removed and is examined to find if the ink has been rightly compounded and if the press is properly adjusted.

If the edges are not white, it shows that the pressure is not sufficient, or that the jelly is too strong. The pressure should be readjusted, screwing the screw immediately under the arch more tightly up than before. If the same defect still shows, the ink must be diluted with water. If the impression is generally too light, it shows that more colouring matter is requred in the ink. If the impression shows clear margins, but is generally too dark, it shows that there is too much colouring matter in the ink, and it must be diluted with jelly containing no colouring matter. Any of these points which require it having been adjusted, printing may proceed regularly. The oily cloth is wiped over the mould after each impression has been taken. The speed of printing is limited by the time required for the gelatine to set. When large numbers of prints are required, a number of moulds and presses are used, these being filled and emptied in succession. The thick edging of ink that adheres to the prints is removed with a spatula, and is kept for future use, as is also the ink that finds its way into the grove around the platen of the press. The prints are commonly treated by immersion for five minutes in a 3 per cent solution of common alum before they are dried, so as to render them insoluble, and therefore less liable to be attacked by damp. After they have passed the alum bath, they are rinsed in water and are allowed to dry spontaneously. They are improved by heavy rolling after they are dry.

The only drawback of the Woodbury-type and Stannotype processes is that it is not possible to get large surfaces of pure white, or of an even very light tint, and specially is this difficult at or near the margin of the picture. For this reason vignettes cannot be printed by these processes.

## CHAPTER XXXV

### PHOTO-MECHANICAL PRINTING PROCESSES—*Continued*

### *Photo-Lithography*

*General Principles.*—The photographer, who has no knowledge of ordinary lithography, can scarcely expect to be able to work photo-lithography, unless he call in the assistance of a skilled lithographer.

To give full instructions in lithography would be quite out of place here. Indeed, it would involve a complete treatise quite as long as this whole book. I shall, however, explain very briefly the manipulations of the simplest lithographic work, and refer the photographer to an excellent manual on lithography for further aid—namely, *The Grammar of Lithography.*[1]

The principles on which the process of lithography depend have been very briefly explained in the introductory chapters. The following are, briefly explained, the actual manipulations :—

On a lithographic stone (which is a slab of a particularly homogeneous limestone found in certain parts of Germany, carefully ground on one surface) a drawing is made, or writing, etc., is done with an ink which consists essentially of grease dissolved in water by the aid of soap, which latter has the effect of rendering oily substances soluble in water.

[1] *The Grammar of Lithography*, a practical guide for the artist and printer, by W. D. Richmond. London : Wyman and Sons, Great Queen Street, Lincolns Inn Fields, W.C., 1880.

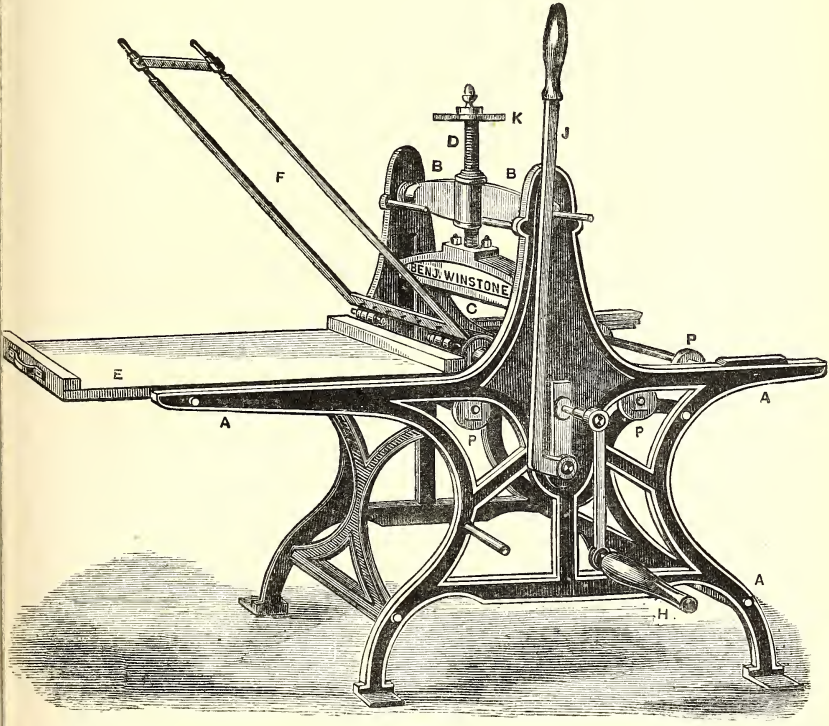
The ink contains black colour merely for the purpose of making the marking on the stone quite clear, and of enabling the draughtsman to see what he is doing. The designs must be reversed. The surface of the stone is now treated with very weak nitric acid to etch it as is said. The process is, however, not in reality an etching one—or rather, although the acid does very slightly *etch* or eat into the stone, this etching is not apparently the really useful function of the acid. What it further does, and what is its essential function, is to neutralise the alkalinity of the soap, which in reality amounts to decomposing it. Soap consists of a combination of oil and alkali, the alkali being in excess, so that a certain quantity more of grease can be dissolved, or perhaps it would be more strictly correct to say emulsified in a solution of the soap. When, however, the alkali is neutralised, the oil of the soap itself, and also any oil or grease that may be emulsified in it, are deposited. The application of the acid to the stone then releases the oil and grease, which sink into the substance of the stone, so that no amount of washing will eradicate it. Besides fluid ink crayons or "chalks" may be used for drawing on the stone. These may be looked upon really as solidified ink. The stone having been etched is "gummed,"—that is to say, is washed over with a thick solution of gum-arabic in water. The precise action of the gum seems scarcely to be understood, but it is essential to the efficient working of the process. The gum "takes" on the parts of the stone where no ink has been, and appears almost to form a combination with the line. At any rate it cannot be washed out of it again with water.

Zinc may be used in place of stone, the surface of the plate being, as a rule, previously grained with sand, and the gum solution being replaced by a mixture of gum, nutgall extract, and phosphoric acid.

Whether stone or zinc be used, the printing is performed in the following manner:—

The surface is damped and is "inked up" by a roller which has been inked on a slab, on which is spread a film of lithographic printing ink This ink consists essentially of a mixture of colour (generally lamp-black), with "varnish," the varnish consisting simply of linseed oil thickened with heat.

The ink "takes" only on the parts that have been drawn upon, and when a sheet of paper is brought to bear




on the surface with sufficient pressure, the ink is taken up by the paper, giving a perfect impression. The operations of damping, inking up, and printing may be repeated indefinitely.

The machine used for printing is a very simple one, and as it is the same as is used for printing photo-lithographic transfers, and may be used for collotype work (to be treated of hereafter), an illustration of it is given.

Here E is the bed on which the stone is laid. This bed can travel from end to end of the frame, A, A, being caused so to do by turning the handle H.

In travelling it passes under the "scraper box" C, which contains the scraper. This latter is simply a strip of box-wood, the length of the scraper box 3 or 4 inches deep and about 1 inch thick, faced on its lower edge with a strip of leather.

In printing, the bed is caused to travel under the scraper, being pressed upwards by a mechanical contrivance actuated by the lever J. This causes the scraper to rub the back of the paper, which is placed on the stone with an even pressure.

F is the tympan frame, whose function is merely to hold a stretched piece of leather or thin sheet metal to be inter posed between the paper and the scraper, so as to protect the former from being torn or otherwise damaged.

### *Lithographic Transfers*

It has already been said that if drawing or writing be done directly on the stone it must be reversed. To obviate the necessity of writing, etc., in a reverse direction—a thing requiring some practice—the *transfer* method is used. Paper is coated with gelatine, gum, or starch, or mixtures of these, and of various other substances. Almost any substance which can be drawn on with lithographic ink, into which such ink will not soak, and which can be afterwards dissolved away by cold or warm water, will serve, the object being to interpose a soluble film, afterwards removable by the application of water, between the paper and the design in lithographic ink.

The design being produced on the transfer paper, the latter is damped and is brought into contact with the stone, which may be dry, damp, warm, or cold according to the nature of the transfer paper and various other circumstances. The stone or zinc plate and transfer paper are now passed several times through the machine. The paper is removed by thoroughly damping it and treating it with warm water, and the composition is also washed away, leaving the design only on the stone, which is then etched, gummed, and printed from in the usual way.

Transfers can also be taken from type work, woodcuts, etc., by taking impressions on these from transfer paper, and transferring these impressions to stone or zinc.

### *Photographic Transfers from Line Subjects*

The principle on which photographic transfers from line subjects are made will now readily be understood if briefly described.

Photographic transfer paper is prepared like ordinary transfer paper with gelatine, with sometimes additions of starch, gum, albumen, etc. It is, however, different from ordinary transfer paper, in that it is rendered sensitive by the addition of some bichromate of potassium or ammonium. The sensitive paper is exposed under a negative of a line subject, when the nature of that part of the surface affected by light is modified in a peculiar manner. If the exposed transfer paper be now rubbed all over with lithographic ink, this ink may subsequently be washed away from the portions which have not been acted upon by light, but adheres to those parts which have, so that an image in ink which may be transferred to stone is obtained.

I give several formulæ for composition wherewith to coat paper for photo-transfer films—

No. 1.

| | |
|---|---|
| Pure gelatine . . . . | 1 ounce |
| Bichromate of potash . . . | 1 ,, |
| Water . . . . . | 15 ounces |

The gelatine is soaked in 10 ounces of the water, the bichromate of potash is dissolved in the other 5 ounces. When the gelatine is thoroughly soaked it is melted with heat, and to the solution is added the bichromate solution.

This solution is poured into a dish at a temperature sufficiently high to keep it melted till as many sheets of paper as are required have been floated on it as described for albumenising paper (see Chapter VII. p. 60). The paper is dried in the dark, and is ready for use when dry.

If it be preferred, the bichromate may be omitted; and the tissue when dry may be sensitised on a 6 per cent solution of bichromate of potash.

No. 2.

The paper prepared with sensitive gelatine and dried is afterwards coated with the following solution:—

| | |
|---|---|
| Albumen . . . . . | 3 ounces |
| Ammonia (strongest) . . . | 160 minims |
| Potassium bichromate . . | 160 grains |
| Water . . . . . . | 10 ounces |

The albumen is switched and filtered as for albumenising paper (see Chapter VII.), but of course has no salt added to it. The potassium bichromate is added to the water, and the water and albumen are mixed.

No. 3.

Paper is coated with a simple solution of gelatine, which may be made of a strength of 10 per cent. This paper is, after the gelatine has set, treated by immersing it for ten minutes in a saturated solution of common alum. It is then washed in cold water, is dried, and is given a second coating of sensitive gelatine made up as by formula No. 1.

*The Negative.*—Whichever formula is used, a negative has first to be prepared of the subject to be reproduced. This negative should show the lines quite clear, and the rest of the film very dense and opaque. Either wet plates or very slow dry plates will be found to be the best for producing such negatives.

*Exposure of the Sensitive Transfer.*—The sensitive paper is exposed in the usual way. As the image is visible there need be no difficulty about this. The colour of the unexposed paper is of course yellow on account of the presence of the bichromate salt. In the case of the first two formulæ the printing must be carried on till the lines assume a deep tawny colour. In the case of the third, the exposure is not carried so far, but is stopped when reaching what may be called a fawn colour.

*Inking and Development of the Transfer.*—The transfer paper is developed in a slightly different manner according to the manner in which it is prepared. For either of the first two formulæ it is necessary to cover the whole face of the paper with a thin film of transfer ink. The ink may be laid on with a sponge, the object always being to secure a very thin and even layer. The right thickness is indicated by the fact that the image is just visible through the ink but is no more than visible. The best way in which to get an even coating is probably to ink up the smooth face of a stone or metal plate with a lithographic roller, to place the face of the sensitive transfer in contact with this, and to pass the stone or plate through the press.

The next part of the process consists in the removal of the ink from those parts of the transfer which have not been acted on by light. To effect this, if formula No. 1 has been used, the transfer is floated, inked side upwards, on a bath of water heated to about 100° F. After a time it will be seen that the surface stands in relief, the *lines* showing as depressions. The transfer is now removed, and is laid—still with the inked side upwards—on a stone or other convenient surface. Warm water is poured on to the surface, when, by the aid of very gentle sponging with a soft sponge, the ink will come away from all parts of the surface except those representing the lines. The application of the warm water is continued till all the gelatine is removed from the whole of the surface whence the ink has been washed. The sheet is then very thoroughly washed in several changes of cold water, and is hung up to dry, when it is ready for application to the stone.

Some prefer to wash away the ink by the application of warm gum-water with a sponge, beginning to pour hot water on the surface only when the lines already stand clearly out.

If formula No. 2 has been used hot water is unnecessary, albumen being soluble in cold water. The process is just the same as that described, but cold, in place of hot, water is used. The paper is, that is to say, first floated, inked side upwards, on cold water, it is then laid on a stone, and the surface is washed with cold water.

The proceeding in the case of formula No. 3 is quite different, the transfer being inked up in such a way that from the first the ink takes on the lines only. The name of Papyrotype has been given to this process.

After exposure, the transfer is merely drawn through water. It is then squeegeed on to a lithographic stone or any other smooth surface, the edge next the operator being fixed to the surface by a little "cobbler's wax" or any other convenient cement.

A roller, which is either one covered with velvet or is of the composition of glue and treacle, or gelatine and glycerine, commonly used for making inking rollers for printing machines, is rolled on a slab, over which has been distributed very evenly an ink consisting of—

| | |
|---|---|
| Best lithographic chalk ink . . | 4 parts |
| Palm oil . . . . . . | 1 pint[1] |

The transfer is now carefully surface dried with blotting boards, and the roller is passed many times over it, working always away from the operator so as to keep the paper stretched. The lines gradually blacken, whilst the ink, if everything goes as it should, does not take on the rest of the surface at all. If the finest lines refuse to ink up, a thinner ink may be used till they do. Whenever the design is quite distinct in all its parts, the process may be considered as complete, and the transfer is hung up to dry. When dry the whole surface is exposed to light to render it insoluble.

*Transferring the Image to the Stone.*—By whatever method the transfer is made, the image is transferred from it to the stone in the following manner:—

The preparation of the stone is a regular piece of

[1] Abney's *Instructions in Photography*, p. 213.

ordinary lithographic work, which it is not proposed to describe here. It consists simply in obtaining a flat, polished surface by grinding, etc.

The stone being ready to receive the transfer, the paper bearing the image is damped from the back. This may be done by laying it face downwards on a sheet of clean paper, whilst a damp sponge is worked over the back, or by first very evenly damping a piece of stout printing paper, laying this on the back of the transfer, a sheet of zinc or other waterproof material on the top of all, and leaving them together for some time.

The stone is warmed either by placing it in front of a bright fire or by pouring hot water for some time on the face of it. In the latter case time must be allowed, after pouring the water on, for the heat of the stone to drive off the last of the surface moisture.

The stone is now placed on the bed of the machine, care being taken to so adjust it, if necessary, by packing paper between it and the bed, that its surface is quite parallel with the edge of the scraper, and with the line of motion of the machine; in other words, that the pressure of the scraper will be even over every part of it.

The damp transfer paper is now laid on the stone, great care being taken that it does not move after the two surfaces have first touched. The tympan is brought down, and the bed of the machine is travelled under the scraper several times, the pressure of the latter on the back of the transfer paper being increased at each stroke by bearing more strongly on the lever. The scraper is now turned end for end in its box, and the bed is travelled several times more under considerable pressure.

The back of the transfer paper is now liberally wetted with water, and after a little time it will be found that it can be removed, leaving the image on the stone. If *cold* water will not serve to render it removable, hot water may be used.

*Inking up the Impression.*—Whenever the paper has been removed, the surface of the stone is wetted with gum-water applied with a sponge. The gum-water is simply a solution of gum-arabic in water, and is made by allowing the gum to soak for several days in cold water. The precise strength of the solution is not of great consequence; it is generally made up to a consistency something like that of olive oil. The stone is now allowed to cool, and is left till the gum is dry.

The roller which is used for "inking up" in lithography is represented in the cut. It consists of a wooden roller

with tapered handles at each end covered with flannel and then with calf-skin. It is held by the two leather handles shown in the cut, which allow it to revolve freely if desired, but permit, also of the application of a certain amount of *drag* by simply closing the hands on them.

To get the roller into condition for work, the leather is saturated with olive oil or some grease that will not dry out, and is then rolled continuously for several days on a slab covered with lithographic varnish, the varnish, which adheres to the leather, being occasionally removed by scraping it off with a blunt knife. When a roller has to be laid on one side, after work, it is covered with tallow or lard, which is removed before work is begun again.

The gum-water being quite dry on the stone, what remains on the surface is washed away with a damp cloth, the surface of the stone is evenly damped, and whilst it is damp, is inked up with ordinary lithographic ink, by passing the roller first over a slab on which such ink has been very evenly distributed, and then over the surface of the stone, which surface must be kept *quite* damp during this time.

*Etching the Stone.*—The etching is done with a very weak solution of nitric acid. No precise strength of solution can be given. It is commonly directed to make the mixture of nitric acid and water "about as strong as lemon juice," but these directions can scarcely be considered as very definite. The following test may, however, be applied:—

A drop of the acid mixture is placed on the margin of the stone. If effervescence begins at once the acid is too strong. If there is no visible effervescence, even after some time, it is too weak. If a slight effervescence shows itself, after a few seconds, the strength may be considered as right.

The acid is spread over the face of the stone with a sponge, is left on it for a few seconds, and is then removed with a damp cloth. Gum-water is once more applied, allowed to rest on the stone for some time, is wiped off, and then the stone is ready to be printed from. This operation cannot be described in all its detail here. It consists in damping the stone, inking up the image with the roller, applying paper, generally slightly damped, bringing down the tympan, and travelling the bed so that the scraper is brought to bear on the back of the paper, and removing the now complete print. These operations go on continuously, gum-water being applied to the stone if it be desired to interrupt the printing for even a little time.

The inking of the stone is the part of the operation that requires most skill. To indicate the variations in result producible by variation in manner of rolling and in the extent to which the ink is thinned with "varnish." I quote from the *Grammar of Lithography* my reason for so doing being that what is said of inking a lithographic stone will, for the most part, apply also to collotype printing to be hereafter described.

"1, *Bearing heavily* on the roller 'feeds' the work more rapidly than bearing lightly on it.

"2, *Light* pressure on the roller transfers but little ink to the stone, and also takes off some part of that which has been previously applied by heavy rolling.

"3, *Slow* rolling produces similar results to heavy rolling.

"4, *Quick* rolling produces similar effects to light rolling, consequently—

"5, *Slow and heavy* rolling combined produce the maximum feeding effect upon the work; while

"6, *Quick and light* rolling combined has the greatest effect in clearing an over-inked job and making the work look sharp.

"A, *Too little ink* upon the roller will produce gray impressions under ordinary conditions of rolling.

"B, *Too much ink* will, on the contrary, give smutty proofs.

"C, *Thin ink* feeds the work very freely, and if too freely used will cause it to thicken and grow smutty.

"D, *Strong ink* leaves the roller with difficulty and necessitates slow and laborious rolling."

Summing up—

"*Slow heavy* rolling with *thin* ink will produce the maximum effect that can be obtained under similar conditions of temperature, and—

"*Quick light* rolling with *strong* ink will have the greatest possible tendency to bring the ink away from the stone."

## *Photo-Zincography*

The operations in zincography are very similar to those in lithography, a sheet of zinc from $\frac{1}{16}$ to $\frac{1}{8}$ inch in thickness being used in place of the stone, the surface being grained for direct writing or drawing, polished, as a rule, for transferring.

The transfer is laid down precisely as directed for stone, after which it is etched with the following solution:—

| | |
|---|---|
| Decoction of nut-galls . . . | $\frac{3}{4}$ pint |
| Solution of gum (thickness of cream) | $\frac{1}{4}$ ,, |
| Solution of phosphoric acid . . | 3 drams |

The nut-gall decoction is made by steeping 1 ounce of bruised nut-galls in 1 pint of water for twenty-four hours.

The solution of phosphoric acid is made by placing a number of sticks of phosphorus in a shallow bottle and pouring in water till the sticks are half-immersed, corking the bottle with a cork having a notch down one side to admit a little air, and leaving the bottle to stand for several days. The water is then a weak solution of phosphoric acid, the thing desired. The same phosphorus may be used a number of times.

This etching fluid is applied in the same way as is the weak acid to the stone. It is washed off and then the zinc plate is gummed in ; it is dried by the application of heat and we proceed as follows :—

With a cloth moistened in turpentine, to each ounce of which a few drops of olive oil have been added, the surface of the plate is wiped till the image nearly disappears, care being taken to remove none of the gum.

The ink roller is now applied, when, the surface being dry, the whole of it will be blackened. Whenever it is evenly black water is sprinkled on it and the rolling is continued, when the image begins to be cleared out again, the ink being rapidly removed from all parts which have not been impressed with transfer ink.

Printing now goes on exactly as described in the case of a stone.

### *Photo-Lithography in Half-Tone*

Strictly speaking, photo-lithography in half-tone is an impossibility, or at least a thing no means of doing which has as yet been discovered ; but it will readily be seen that if by any means a photograph in real half-tone is translated into a representation of half-tone by dots, cross-lines, stipple, or such-like, as we have it in various kinds of engravings, this could readily enough be reproduced by lithography, being, of course, transferred by the methods just described on to stone or zinc.

There are various methods of producing grained interpolation of half-tone, some of which are suitable to lithography, whilst some, from the exceeding fineness of the grain, are not the result of an attempt to use them being a clogging of the impression.

A special chapter will be devoted to the question of the different methods of obtaining grain applicable to lithography, and here I shall only say that if a grained *stone* be used in place of a polished stone, and an impression on transfer paper from a half-tone negative be transferred to it, an image will be the result, which, although very imperfect as regards half-tone, may serve as a basis for hand-work.

# CHAPTER XXXVI

## PHOTO-MECHANICAL PRINTING PROCESSES—*Continued*

### *Collotype*

*General Principles.*—The name Collotype is now almost universally used in this country, and Lichtdrück in Germany, to designate the process of printing in greasy ink from a surface of gelatine.

It has already been explained in the introductory chapters that if a film of bichromated gelatine be dried at a pretty high temperature, be exposed under a negative, be then washed in water and dried, it will, when treated in the same way as a lithographic stone, display similar properties,—will, that is to say, absorb water and refuse a greasy ink in certain places, whilst in others it refuses water, but subsequently takes ink.

The portions which take water and not ink are those which have not been affected by light, whilst those which take ink readily are those which have been greatly affected by light. Between these two extremes is a complete gradation represented in reality by a reticulation or grain, but giving the impression, so fine is this reticulation, of a true half-tone.

The close analogy between this process and that of lithography will be readily seen, and, in fact, it was in attempts to impress on lithographic stones images, which could be inked up like ordinary lithographic images, that collotype came first to be invented. Naturally one of the substances first applied to the surface of a stone in the attempt to transfer an image to it was bichromated gelatine, and it was not for some considerable time that it was discovered that the *stone* in fact had nothing to do with the effect obtained further than inasmuch as it acted as a support for the gelatine film, and that other supports would do as well or better.

The difficulty found in all the first attempts at collotype, or, as it was then generally called, photo-lithography, arose from the reason, that, after a few impressions had been taken, the film tore away from the support whether it were stone, a metal plate, or glass.

The first real advance was made by Tessie de Motey, who used a copper-plate, the trichromate of potassium in place of the bichromate and a reducing agent. The copper in these circumstances had the effect of rendering the portion of the film in direct contact with it quite insoluble, and therefore making the adhesion very complete.

This process, I thought, had become an affair of history only, having long passed out of use; and was surprised, on recently visiting the works of Mr. Ernest Edwards of Brooklyn, New York, to see it in practical use. I am sorry that I cannot give precise formulæ or instructions for working it, as it seems to be in Mr. Edwards's hands a thoroughly practical working process. The copper-plates having the advantage over the glass plates now generally used of non-ability to breakage.

In general use, the process of Tessie de Motey was soon superseded by that of Albert, in which a plate of glass was coated with a film of bichromated gelatine. When the film was dry, the plate was laid face downwards on a black surface, such as a piece of velvet, and was exposed to light. The light acting through the glass formed an insoluble substratum which adhered very firmly to it and securely fixed to the plate a second coating of bichromated gelatine, to be afterwards exposed under a negative.

This process is, I believe, still worked by some collotype printers; but I believe that far the majority now use the process which is due to Husnik. In this process a plate of glass ground on one surface is used as the support, and a mixture of water, glass, and albumen is used on this ground surface as a substratum for the final film.

The principle adopted by Albert of exposure from the back of the glass is still made use of to a slight extent at the present day with Husnik's process, as is also the discovery made long ago by Edwards, that the whole film might be acted on by alum to a certain extent, being thus toughened, and might yet be quite serviceable as a printing surface for greasy inks.

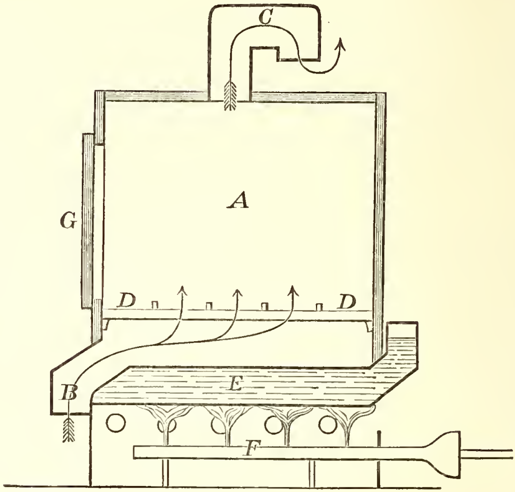
### *Preparation of Collotype Plates*

The chief requirement for the preparation of collotype plates is a suitable arrangement for drying the films. These have to be dried at a temperature of 120° to 140° F. in some place where there is a free admission of air. Some dry over an arrangement of two cast-iron plates between which water is kept boiling, a shallow boiler in fact, the upper surface of which is fitted with three projections forming a tripod to hold each plate in a level position.

If this arrangement be used, it is necessary to take precautions against dust by covering the plates with a framework having muslin stretched over it, or by some such plan.

The water heater used in the open is much inferior to a drying box, much in the form of an oven, commonly used. In this latter arrangement the temperature may be adjusted to a nicety, whilst it is easy to guard against dust by stretching muslin over the air entrance passage.

There are many forms of drying box with various means of heating them. I illustrate one overleaf. A is the body of the box, with air inlet B, outlet C. D, D is a framework of iron with small projections carefully levelled, so that plates when placed on these will assume a horizontal position. The box is heated by a boiler E kept at the temperature necessary to heat the interior of the box to the desired degree by aid of the atmospheric burner F. A door G can be opened to place the plates in the box and to remove them. There must be a thermometer so arranged that, whilst the bulb is inside the box the index is outside, and can at any rate be read from the outside.




Some appliance is necessary for filtering the sensitive compound, it is necessary to keep up the temperature to a certain degree during the whole of this process. A useful appliance is made for the purpose of filtering solutions which require to be kept hot. It consists of a funnel stand, with a hot-water jacket for the funnel. Such an arrangement may be used by the collotype printer; but if he have a drying box, he can readily enough filter a gelatine solution by placing the funnel and receiving vessel in the box, or, indeed, he can keep the solution liquid by working in front of an ordinary open fire.

The glass should be thick plate. For small sizes it need not be thicker than $\frac{1}{4}$ inch, but for large sizes it should be about $\frac{3}{8}$ inch thick. The great essential is that it be perfectly flat.

The production of a ground surface is so very simple that the photographer will probably prefer to produce it himself when he requires it rather than to purchase it ready ground for him.

Two plates of glass are taken, a little flower-emery and water are laid on the face of one, and the other is worked with a circular motion over it. The result in a very few minutes is a depolished surface.

The chemical substances used for the films of the plates are all well known to the photographer, and the only one that calls for any particular mention is the gelatine. It will readily be believed that on the quality of this depends, in a great measure, the success or the reverse of the process. The qualities most desirable in a gelatine for collotype work are freedom from foreign bodies of any kind, and the property of withstanding long immersion in water, without either spontaneously becoming liquid, or absorbing a very great quantity of water. There are various gelatines in the market which are specially sold as suited to collotype work, and doubtless any of these got from a respectable dealer will serve the required purpose.

Albert, who must be heard with respect on all matters pertaining to collotype, has the following remarks on the choice of a gelatine for the particular work we are considering :[1]—

Gelatines of excessive hardness and of excessive softness are both ill-suited to collotype work; the hard gelatine giving a film which soon breaks up in printing, the soft gelatine giving a plate from which vigorous impressions cannot be obtained. He recommends the use of "middling hard gelatine," and mentions a special brand, that of F. Creutz of Michaelstadt, Hesse, as particularly good.

He gives the following means of discovering whether a gelatine is suitable for collotype work as regards hardness :—Two portions of it are made up, one with bichromate of potassium (either of the two formulæ to be presently given may be used), the other with bichromate of ammonium, substituted for the bichromate of potassium. Plates are coated with these solutions, and are dried at

[1] *Photographic News*, March 25, 1887, p. 185.

120° F. If they both show a polished surface, the gelatine is too hard. If they both show a mat surface, it is too soft; if that prepared with bichromate of potassium show a mat surface, that with bichromate of ammonium a polished surface, the gelatine is of the right hardness.

It may be taken then that if a gelatine is free from foreign substances, if it shows a good result when the test just described is applied, and if it will bear soaking for forty-eight hours in water at a temperature of 60° F., it is suitable for collotype work.

### *The Albert-Type*

The above name has been given to Albert's process. As some may like to give it a trial, I give briefly one of several modifications of the process which have been published—

A.

| | | |
|---|---|---|
| No. 1. | Hard gelatine . . | $\frac{1}{4}$ ounce |
| | Water . . . . | 6 ounces |
| No. 2. | Bichromate of potassium . | $\frac{1}{4}$ ounce |
| | Water . . . . | 6 ounces |

The gelatine is soaked and melted in the water with heat, and solutions 1 and 2 are mixed.

B.

| | |
|---|---|
| Albumen . . . . | 6 ounces |

This is made from fresh eggs, is beaten into a froth, and is then filtered.

C.

| | | |
|---|---|---|
| No. 1. | Collotypic gelatine . . | 1 ounce |
| | Water . . . . | 12 ounces |
| No. 2. | Bichromate of potassium | 80 grains |
| | Water . . . . | $1\frac{1}{2}$ ounce |

The gelatine of No. 1 is soaked in the water and melted by heat, and Nos. 1 and 2 are mixed together.

A is filtered through cambric at a temperature of about

120° F. It is allowed to cool to about 100°, and B is added to it. The mixture is kept at a temperature not exceeding 100°, and the glass plates, previously carefully cleaned, as if they were to receive a collodion film for the wet process, are coated thinly with the solution. They are laid on a level slab till the gelatine has set, and are then dried in the dark at an ordinary temperature.

When the film is dry, the plate is laid face downwards on a piece of black velvet, and is exposed to light till the colour changes from a bright yellow to a dark brown. It is then very thoroughly washed in warm water till the colour is entirely removed.

The plate is now ready to receive the final coating, but may be kept almost indefinitely if it be desired.

C is now heated to a temperature of about 150°, and is filtered through two thicknesses of cambric. Such plates as it is desired to use, already coated with the substratum as described, are raised to about the same temperature as the solution (150°), and are coated, the thickness of coating given being somewhat less than would be given to a dry plate. They are then placed in a horizontal position in the drying cupboard, the temperature is raised to about 140°, and is kept at that till the films are dry.

The plates may be used whenever they are dry, or may be kept in a cool, dry, and of course dark place for several days if it be desired.

Printing under the negative is done just as described for Husnik's process; after it is over, the films are submitted to a long-continued washing to remove the whole of the bichromate; they are then dried, and are ready to be printed from.

## *Husnik's Process*

I have given the above name to the process of collotype, now most commonly worked, because I believe Husnik was the first to publish the distinguishing feature of it—namely, the use of a substratum of water glass and albumen on a ground glass surface. If he was not the first actually to publish it, he was certainly the worker who had the chief influence in popularising it. I have gained much assistance in my investigations in this process from the publication of Schnauss on *Collotype*.[1]

A.

| | |
|---|---|
| Albumen (switched) . . . | 8 ounces |
| Commercial water glass solution . | $3\frac{1}{2}$ ,, |
| Water . . . . . . | 10 ,, |

B.

| | |
|---|---|
| 1. Collotype gelatine . . | 1 ounce |
| Water . . . . . | 12 ounces |
| 2. Bichromate of ammonium[2] . | 80 grains |
| Water . . . . | $1\frac{1}{2}$ ounce |

The water glass solution in A should be of the consistency of syrup. The three ingredients are mixed, and are switched into a froth either by the aid of an American egg-beater, or by placing the mixture in a bottle with pieces of broken glass and violently shaking the bottle. The froth is then poured on the filter paper. The fluid which passes through is preserved.

To prepare B, the gelatine is allowed to soak in the water for about an hour, when it is melted by the aid of heat; solution No. 2 is then added. The whole is now filtered through a double thickness of cambric, when it is ready for use.

The plates are ground on one surface as already described. They are carefully cleaned, and are then coated with solution A. This flows readily over the surface. As much excess as possible is poured off, and the plates are dried in an inclined position at the ordinary temperature of the operating room. When dry they are thoroughly rinsed, and are once more dried. In this condition they will keep almost indefinitely. When it is required to use

[1] *Der Licht Druck und die Photolithographie.* Von Dr. Julious Schnauss: Düsseldorf Ed. Leisegang's Verlag.

[2] Albert recommends the use of bichromate of potassium rather than bichromate of ammonium, stating that many of the troubles which crop up in collotype work are due to the use of the latter salt.

the plates, they are coated with solution B in the following manner:—Such plates as are required are heated to a temperature of about 140° F., and the solution is heated to the same point.

A plate is taken in the left hand, and is balanced on the tips of the finger and thumb; a card mount being placed under it if it be found too hot for handling.

A pool of the solution is now poured on the upper surface—that with the substratum, of course—and the plate is quickly tipped, so that some of the solution is poured off at each corner. The plate is now rocked slightly so as to cause the liquid to spread itself in a perfectly even film, and is immediately placed in the drying box.

It is impossible to say precisely how much solution should be left on the plate; but it may be said that if the thickness of the film be right, the drying, at a temperature of 120° to 140° F. with a good supply of air, will take about an hour.

### *Exposure of the Plates*

Unless reversal of the final prints is permissible, it is necessary to have reversed negatives to print from. There are various ways of producing these. The first and best, where it is possible, is to use a mirror or prism as a reflector in front of the lens of the camera. Another is to expose in the camera *through* the glass. It is unnecessary to say that if this expedient be had recourse to, the back of the plate must be cleaned very carefully. The method of reproducing by the powder or "dusting on" process has already been mentioned.

I am aware that some photo-mechanical printers produce reversed negatives by taking advantage of the fact that a very long exposure produces, in the case of a dry plate, a reversed action of light, so that, giving a gelatino-bromide plate a very long exposure in contact with a negative, a negative is the result on development. I have seen excellent results produced in this way, but must confess that my own experiments have not been very successful.

A roundabout way in which to produce a reversed negative is to make, from the original negative, a transparency in the camera, turning the back of the negative towards the lens, and to make a negative by contact from a transparency.

In the days of wet plates, it was a common thing to strip the film, which must not be varnished, from the plate, when exposure might of course be made in the printing-frame so as to give an image direct or reversed as might be desired. The method of stripping is as follows :—

| | |
|---|---|
| Gelatine . . . . . . | 3 ounces |
| Glycerine . . . . . | 1 ounce |
| Water . . . . . | 15 ounces |

The gelatine is soaked in the water, is melted with heat, and the glycerine is added. This composition is poured over the film of the plate and is allowed to dry, when the double film of collodion and gelatine may be stripped away.

I believe that stripping is not commonly resorted to in the case of gelatine dry plates, but it is quite possible to do it; Plener having indicated how it may be done. The film is coated with the solution given above. It is then hardened by allowing it to soak for ten minutes in a saturated solution of chrome alum, is thoroughly washed in cold water, and finally left to soak for half an hour in a 25 per cent mixture of glycerine and water. The surface moisture is blotted off with blotting-paper, the film is dried, and the plate is placed in a weak solution of hydrofluoric acid. This in time soaks through the film, dissolves away the surface of the glass, and causes the film bearing the negative to float away from the plate. The film is now squeegeed down to a sheet of vulcanite to dry.

As regards general quality of a negative for collotype work, it may be said that one which is suitable for silver printing will also serve well for collotype.

It is advisable to use a collotype plate which will allow an inch of margin all around the negative; and this margin is protected from light by an opaque paper mask glued to the edge of the negative and to the plate glass of the printing-frame.

Special frames are made for collotype work, but an ordinary frame with plate glass front may very readily be adjusted so as to take the extra thickness of the plate glass bearing the gelatine film.

The collotype plates are ready to be printed from whenever they have cooled after coming from the drying box; but they may be kept for several days in a cool dry place, carefully protected from light of course. It may be well here to say that in all the manipulations of collotype plates, from the coating to the washing after exposure—to be afterwards described—about the same precautions against actinic light should be taken as in the case of albumenised-sensitised paper. It is well to take this precaution even when the plate is wet, although in this condition it is by no means so sensitive as when it is dry.

The plates *may* be kept for several days before they are used, and some prefer so to keep them, considering that better results are to be obtained from plates that have been kept for some time than from those that are quite new.

The plate is exposed behind a negative in the usual manner, and the progress of the printing is observed from the back through the glass. The exposure is sufficient when the details of the high lights just begin to be visible. The colour of the image is a light brown on a bright yellow background.

The exposure over, the plate is laid film side on a piece of black velvet, and a certain exposure is given from the back. It is difficult to tell exactly how long this exposure should be; but it may be said that if a piece of sensitised-albumenised paper be exposed alongside of the plate, the latter will have had exposure enough when the paper has become dark chocolate colour. In high diffused light (not direct sunlight) five to ten minutes will be found to be long enough.

### *Development of the Plate*

The plate is developed merely in cold water. Whenever it is placed in the water, a curious change takes place—the image shows in a certain relief, the high lights swelling up, at the same time the whole of the film, except those parts representing the deepest shadows, develops a fine grain of the nature of a *reticulation.* This grain should be so fine that it is barely visible to the naked eye.

The development is continued by washing the plate with continuous changes of water till the last trace of bichromate is washed from the film, as indicated by the complete absence of colour in the washing water. The image will now be all but invisible but by reflected light, showing the relief; the image by transmitted light being of a very faint brown colour.

The plate is now laid for one hour in a 1 per cent solution of alum, is again thoroughly washed, is surface-dried with blotting-paper, or is soaked for five minutes in a bath of spirit, and is reared up to dry. It is well, if possible, to allow two or three days before the plate is used for printing, although it may be put in the machine whenever it is dry.

### *Printing from the Plate*

To *teach* collotypic printing to one quite unpractised in that or any analogous descriptions of printing merely by giving instructions is a thing that is quite impossible. A skilled lithographic printer, if the manipulations of collotype printing be described to him, will very soon master the more delicate process; the operator who is ignorant altogether of printing can expect to become expert only by long practice. His labours will certainly be greatly facilitated if he can get a printer already skilled in working collotype to help him.

The principles involved in collotype printing are the same as those in lithographic printing, but the process is in every way more delicate than the ordinary run of lithographic work.

The ordinary lithographic press may be used for collotype printing; but presses are made specially for the latter process which are better suited than lithographic presses for the special work for which they are designed.

There is no gumming or etching in collotype printing as in lithography. The plate is simply damped, inked, and passed through the press; but in damping it is a common practice to add to the water some deliquescent substances, which prevent evaporation and make it unnecessary to damp the plate again till a considerable number of prints have been pulled. This treatment with water and deliquescent substances is commonly termed *etching*, although the name is really a misnomer.

A quantity of this "etching fluid" may be made up as follows:—

| | |
|---|---|
| Water | 12 ounces |
| Glycerine | 1 pint |
| Common salt | 30 grains |

Or 2 parts of water may simply be mixed with 3 parts of glycerine.

The plate is left for two hours in this solution, is surface-dried with blotting-paper, and is fixed to the bed of the press. If it be left wet on the under side, it will fix itself with sufficient strength without further cement of any kind, but it is common to fix it down with plaster of Paris.

The outer edge of the plate is protected with a mask of paper, so arranged that it can be lifted away before inking and be replaced afterwards. This is to secure perfect whiteness of the margins.

The ink is made up like lithographic ink, but it is commoner to use brownish or purple colours in place of black. It is also customary to use two thicknesses of ink, with two inking slabs, and two rollers.

The thicker ink is applied first. It takes on the deepest shadows, only giving them strength. The thinner ink is next used, and brings out the finer and more delicate details without harming the shadows.

The paper used for large work is generally good quality sized printing paper. It is made slightly damp before use. For small and very fine work chalk-surfaced paper is used without damping.

After a dozen or so of impressions have been pulled, or before that if the high lights show any indication of taking ink, the surface of the film is damped with the etching fluid.

Some prefer to damp with plain water in place of a deliquescent fluid. In this case it is necessary to damp after each impression, a damping cloth being used.

It must always be borne in mind that an indefinite number of prints cannot be expected from one collotype plate. There are, it is true, exceptional cases when the weather is cool, and when all other circumstances are favourable, when thousands of copies may be pulled from one plate; but in average circumstances only a few hundreds can be expected, and there must be no disappointment if the film break down after a few dozen prints have been produced.

Taking these circumstances into consideration it is desirable to make, in the first place, a number of collotype plates if a very large number of prints be desired.

The prints are varnished or are left unvarnished according to the taste of the public for whom they are produced. Husnik recommends a varnish consisting of 1 part of gum-mastic and 2 parts of shellac dissolved in alcohol. Frequently a water varnish, made by dissolving shellac in a hot solution of borax, is used.

### *Printing by Machine*

Concerning machine printing of collotype it is unnecessary to do more here than state that machines are now commercially produced for the purpose of collotype printing, capable of turning out several thousand impressions in a day, and that these machines in skilled hands give excellent results, the plates, according to Mr. E. Edwards, lasting better under them than under hand-presses.

### *The Heliotype Process*

The process to which the above name has been given will be understood by the aid of a very brief description if the process of Husnik be first mastered. Heliotype differs from other collotype processes, in that the sensitive film before exposure is separated from the glass on which it is prepared, is manipulated as a film, and is then cemented down to a pewter plate for development and printing.

Formulæ—

A. [1]

| | |
|---|---|
| Gelatine . . . . . | $1\frac{1}{2}$ ounce |
| Glycerine . . . . . | 1 dram |
| Water . . . . . . | 12 ounces |

B.

| | In Summer. | In Winter. |
|---|---|---|
| Bichromate of potash | 22 grains | 30 to 40 grains |
| Chrome alum . | 15 ,, | 7 to 15 ,, |
| Water . . | 12 drams | 12 drams |

Glass plates are ground on one side and are waxed, by pouring on to the ground surface a solution of white wax in ether, and afterwards polishing off as much as possible with a clean cloth.

The plates are now heated, and the waxed sides are coated very thickly with the solution made up by mixing A and B and raising it to a temperature of about 140°. About as much solution is poured on to the plate as will lie on it without spilling off at one edge or another. Drying is now performed at the comparatively low temperature of 75° F.

When the films are dry, they may readily be stripped from the glass.

The *ground* or grained surface of the film has now to be exposed by placing it with the smooth surface on a piece

[1] Abney's *Instructions*.

of black velvet, and allowing the light of the sun to act on the other side.

The exposure must be continued till the action of the light has just penetrated the film. To gauge the exposure a small portion of the film is cut away, and a mash of opaque paper with a small hole in it is made to cover this small fragment of film. The film covered with its mask is now placed under one edge of the film which is being exposed. Whenever the image of the hole in the mask appears visible in the film under it the exposure is sufficient.

The smooth side of the film is now exposed under a negative in the manner already described for Husnik's process.

A polished pewter plate somewhat larger than the film is now coated with a solution of rubber in benzole—a strength of 5 or 6 grains to the ounce being a suitable one. The film is allowed to set, the plate is placed in water, the film is brought with its grained side into contact with the rubber film, the plate and film are removed from the water together, and the film is firmly squeegeed down. The film is edged with rubber solution to prevent water from penetrating, after which the plate is developed by washing with water till all bichromate has been washed from the film. The surface of the skin is dried with blotting-paper, after which printing may begin at once.

## CHAPTER XXXVII

### PHOTO-MECHANICAL PRINTING PROCESSES—*Continued*

#### *Etching Transfers on Zinc to Produce Relief Blocks*

*General Principles.*—When prints are pulled from stones or plates in the way already described, the principle involved is quite different from that involved in pulling a print from type or from a wood block. In these latter cases the portions of the surface which are to print dark are raised above the others in place of being on the same level, and differing only in their power of attracting a greasy ink.

The advantage of blocks with raised surfaces is that they may be "set up" with type and may be printed at the same time, whereas impressions from stone or zinc must be taken by a separate process.

If it be considered that the ink which is transferred to a zinc plate, as described in Chapter XXXIV., is of a greasy nature and has the property of repelling all or almost all aqueous solutions, whilst the rest of the surface of the zinc has not, and if it be borne in mind that certain of these solutions—as, for example, nitric acid—have the property of dissolving away zinc whenever they come in contact with it, it will be seen that by simply placing a zinc plate in such a solution we should have a ready means of producing a relief block, the solution eating away those parts of the surface not protected by fatty ink, leaving those protected in relief.

Unfortunately the process in practice is not quite so simple as that just indicated, and this for two reasons. The fatty ink image, unless intensified in some way, has barely power of resistance sufficient to prevent the acid used from penetrating it to a slight extent, and making the lines porous or "rotten," and, moreover, the action of the acid is unfortunately not only vertical but also lateral, inclining to undermine and eat away the lines. The great difficulty in etching lies really in contriving, by various means, to prevent or counteract this lateral action of the etching fluid. The following is a fairly complete account of one of several methods of etching which differ a little from each other:—

### *Materials for Etching*

Besides all that is necessary to produce a transfer on a zinc surface as already described, the following are needed for etching:—Sundry dishes rather larger than the plates to be etched, of white stoneware or other acid-resisting material, several broad, flat camel's-hair brushes for brushing the bubbles from the surface of the plates, finely-powdered resin or colophony, and finely-powdered asphalt, also a special smooth or polished inking roller, made by rolling the ordinary leather roller in red lead and oil.

Three baths of different strengths are commonly used in etching, and these strengths are generally made up by working to specific gravity, as commercial nitric acid is itself a substance of not very definite strength. The Baumé hydrometer is usually employed for taking strengths. For average work the three baths may be made up as follows:—

| | | | |
|---|---|---|---|
| No. 1 bath . . . . | 2° Baumé | at | 65° F. |
| No. 2 bath . . . . | 10° | „ | „ |
| No. 3 or deep etching bath . | 18° | „ | „ |

These strengths are approximate only. Thus for very fine work it may be necessary to begin with a bath weaker even than No. 1, whilst for rough work a stronger bath may be used even at once. Again the baths quickly lose strength if in continual use. For this reason the first bath has, after a time, to be rejected, bath No. 2 takes its place, bath No. 3 takes the place of bath No. 2, and a fresh "deep etching bath" is made up.

The baths must be so arranged that a rocking motion can readily be given to them.

A transfer is impressed on the surface of a polished zinc plate as already described, great care being taken to have the lines very perfect, and to ink them up with as much ink as they will stand without danger of spreading. A thin line of ink is then applied round the margin of the plate.

There is now dusted over the plate with a dry camel's-hair brush finely powdered asphalt. This adheres to the lines. The dusting process is continued for about one minute, by which time the ink is saturated with asphalt. The powder which rests on the other parts of the surface is carefully dusted away with the brush and with cotton-wool. The plate is now gently heated till the brown colour of the asphalt powder changes to a black, indicating that it has melted and become incorporated with the ink. At this moment more asphalt powder is dusted over the surface, which will adhere to that already melted. The excess is again carefully removed, and the plate is gently heated to incorporate the additional asphalt with that which was dusted on before. This second heating must be very carefully done lest the finer lines thicken by the spreading of the asphalt.

The plate may now be laid in the weakest of the three etching baths. Whilst it lies therein, the surface is continually worked over with a very soft brush, just allowed to touch the metal. This is to equalise the action of the acid.

After two minutes the plate is removed from the acid, is rinsed with water, and the effect is observed. If the action has proceeded quite evenly, the plate is returned to the acid. If, on the other hand, any parts of the lines appear to be breaking down under the action of the acid—a thing which may be due to error in any of the operations previous to dipping the plate in the acid—such parts must be retouched or put in by hand, using a thick solution of asphalt in turpentine, the plate being previously dried by blotting off and gently heating. It is then returned to the acid bath for another period of two minutes, when it is again examined as before. If the lines be very fine, the plate will probably by this time have had all the etching that it can stand without further protection; further etching endangering the lines by the under-cutting of the acid. Only experience can enable the operator to tell when he must stop the etching, but with work of average fineness, a third period of three minutes may be given. As soon as the finger-nail can catch on the margin line of the plate, the etching is deep enough.

The plate is now thoroughly rinsed, and is dried by blotting off and gently heating. The temperature is raised to between 110° and 120° F., and very fine resin powder is dusted over it with a brush. The warm image holds the powder, and the excess can be removed by rubbing with a brush and cotton-wool, and finally by hard blowing. This blowing may be done with an ordinary pair of bellows, such as is in domestic use. Those who do zinc etching on a large scale commonly use a specially constructed bellows, which is in the form of a vertical cylinder, has a stand on the top for receiving the plates, and a tube which can be bent, so as to direct the blast on to any part of the image, whilst blowing is done by working a lever.

The temperature is raised a little, and a second application of powdered resin is made, and the plate is cleaned as before by dusting and blowing. The heat is now gradually raised till it is seen that the resin begins to flow, so as to widen the lines. At this moment the plate is removed from the light, and asphalt powder is dusted over it. This is caught by the now tacking resin. The plate is cleared of the excess of asphalt powder, the temperature is raised to about 150°, the operation is repeated, and the temperature is raised till this last coating of asphalt powder thoroughly incorporates itself with the others. It will now be found that the *sides* of the lines have been covered with the flowing resin and asphalt with wonderful regularity.

Indeed, there appears to be no difficulty in securing the regularity of flow, the only real difficulty, or rather the only thing that requires great care, is the complete removal of the powder that falls on those parts of the plate between the lines. Any trace of resin or asphalt left there interferes greatly with the progress of the etching.

The back of the plate is at this stage varnished with the solution of asphalt in turpentine, or with ordinary shellac varnish, and the plate enters the first etching bath once more. Here it is etched as before for periods of two minutes at a time, a careful examination being made at the end of each period. The finest lines are always examined to discover if there is any sign of breaking down, a magnifying glass being used. If the operations of protecting the lines have been rightly done, the plate should stand at least two, very likely four periods, of two minutes each.

This finishes the etching in the first etching bath, which is supposed to give the depth required between very close lines, this depth being much less than that needed between lines which are somewhat far apart and still less than is required for large spaces which must print white.

The image is now cleaned with turpentine, the last trace of this being removed by rubbing the plate with sawdust. If the etching has gone on as it should, the image will appear clearly with the original polished surface of the plate, the remainder of the surface being dulled with the acid.

The image has now to be inked up again. The polished roller and a very thin ink are used for this. The ink is made out of equal parts of paraffin, tallow, bee's-wax, and ordinary printing ink. This ink has about the consistency of butter. It greedily licks up resin, and, when warmed with this latter so as to be incorporated with it, forms a solid but somewhat brittle substance.

The plate is very carefully rolled up with this ink so that a very even coating is given. Scarcely any pressure is used, and only the tops of the lines should receive the ink. It is, however, impossible to prevent any large spaces between lines from taking the ink, nor is this of consequence, only next all lines there must be an inked space of at least $\frac{1}{16}$ inch wide.

The plate, inked up, is dusted with powdered resin till the ink will absorb no more of it. It is then dusted, and is warmed till the resin becomes tacky, but does not melt or spread. A second application of resin is now made again to saturation, the plate is cleaned of excess, the temperature is raised to about 120°, and the plate is powdered with asphalt powder; the excess is again removed, the temperature is raised to about 150°, once more asphalt is applied, and the excess is removed. The temperature is now raised till the resin and asphalt flows and shows a bright surface. The protective film is allowed to spread so that even the spaces between very fine lines are filled up, then, as has already been said, having been given all the depth that is required.

The back of the plate is varnished as before, and the protective film is scraped away from those portions of the wide spaces between lines where the ink having taken, the resin and asphalt have taken also. The film being brittle, this removal is quite easy.

Etching now proceeds in the second bath. It may be allowed to proceed during periods of three minutes each. At the end of each period the plate is examined as before, and any tendency to failure of the protective film is made good with the solution of asphalt in turpentine. As a rule three or four etchings of three minutes each will give a sufficient depth, but the best way in which to judge of the action is as follows:—

A slight ridge will always show itself between where the etching in the first bath left off and that in the second began. This has, as will afterwards be explained, to be removed. The etching in the second bath should, however, be allowed to proceed so far that, by under-cutting or lateral action, the ridge is reduced to quite a trifling size. The progress may always be examined by scraping away a little of the protective film on the margin of the plate.

The plate, after sufficient etching has been given, is cleaned with turpentine and sawdust as before. The progress of the action may be judged of by noticing whether what we may call the "contour lines," formed by the ridge just mentioned, everywhere run parallel with the lines; if all has been properly performed, they will.

The third etching comes now to be performed. The object of this is merely to eat away to a considerable depth those parts of the plate which are at some distance from lines.

The image is inked up with the soft ink as before, but this time a large quantity of ink is used and is freely applied, so that it not only covers the tops of the lines but works its way down the sides of them to some distance, filling in also the spaces between very close lines. If the roller refuse to do this in any part, the ink is forced in with a dabber.

The incorporating of resin and asphalt with the ink also goes on precisely as described before, the last heating allowing the covering to flow considerably. The large spaces between lines which may have taken ink are again scraped clean, the back is varnished, and etching goes on in the third bath.

Periods of five minutes each are allowed in this bath, and progress is judged of as before. The action is allowed to proceed, that is, till the ridge between the result of the second and of the third etching is made quite small by the lateral action of the acid. Probably five or six periods of five minutes each will suffice. As a rule the protective film will stand the necessary etching without breaking down. If, however, it shows signs of giving way—other than those purely local, which can be corrected by hand-touching with asphalt solution—the plate must be cleaned, again inked up, etc.

After the deep etching is over two more etchings are still necessary to remove the ridges left by the first three etchings.

The plate is cleaned; inking and dusting on are performed in such a way that the protective film spreads sufficiently to cover the ridge nearest the lines, but not the second ridge (produced by the final etching), and the plate is etched for two or three periods of three minutes each in the second bath.

The plate is once more cleaned for the last etching. It is very carefully inked up with the thinnest ink and the lightest possible pressure, and is dusted only once with asphalt powder, which is heated so as to spread but slightly, not so far as to the first ridge. The etching is performed with great care in the first bath, periods of one minute each being allowed. When the last ridge has disappeared the etching is finished. The plate is once more cleaned, any small portions of either of the ridges which may have been left on account of the irregular spreading of the protective film are removed with a graver; the plate is mounted on wood, so as to have the regular height of type, and is then ready to be put up with ordinary matter for the press.

The process which has been described is, as already stated, only one of several which are worked. It appears, however, to be the most easily worked of any. It is commonly known as the "Austrian Method of Etching." I have to mention my indebtedness to J. O. Mörch [1] for my knowledge of the details of the process, which I first acquired through his very clear description of it. The object of using first resin then asphalt in giving a protective film is that the resin, melting at a much lower temperature than the asphalt, may be used as a means of attracting the latter at a moderate temperature, so that a thicker film is got than otherwise could be.

[1] *Handbuch der Chemigraphie und Photochemigraphie.* Nach eigenen Erfahrungen bearbeitet. Von J. O. Mörch: Düsseldorf Ed. Leisegang's Verlag.

# CHAPTER XXXVIII

## PHOTO-MECHANICAL PRINTING PROCESSES—*Continued*

### *The Asphalt Process for the Production of Line Relief Blocks*

*General Principles.*—The method of producing surface blocks by the transfer method described in the last chapter has certain drawbacks. Thus the damping of the transfer paper produces a slight amount of distortion. This is so small that for the great majority of subjects it is not of consequence, but where great precision is necessary this distortion may be a serious drawback. Moreover, unless the process be carried out with the extremest skill, there is a liability to loss of delicacy in the finer lines.

When distortion is inadmissible, or indeed, whenever the finest work is wished for, it is best to print directly on a film of asphalt on the surface of the zinc plate.

Asphalt, bitumen, or mineral pitch, was used in camera photography in the very earliest experiments made by Niepce. In 1814 he made camera pictures by its aid. The substance is sensitive to light, inasmuch as, when dissolved in benzole, chloroform, or other solvent spread in a thin film, and allowed to dry, light has the effect of rendering it no longer soluble in these fluids.

The length of exposure necessary to render an asphalt film insoluble is very great, but it has been materially lessened by the discovery that a certain portion of the bitumen is soluble in ether, that this portion is quite insensitive to light, and that, if it be removed, what remains is much more sensitive than is the bitumen before it is thus treated.

If a zinc plate be covered with a thin film of varnish, made by dissolving in benzole, this residue left after dissolving in ether as much of the bitumen as is soluble, if this plate be exposed under a line negative, and be then developed by dissolving the bitumen from those parts which have not been acted on by light, the result is an image in bitumen which may be etched in the manner described in the last chapter.

### *Preparation of the Bitumen Varnish*

The older method of preparing the bitumen for photography was to powder the asphalt, and to soak it in ether till all that could thus be dissolved away was taken up by the ether.

However carefully this process was carried out, a certain amount of ether-soluble bitumen was still left behind, with the result that the residue gave a film less sensitive than the asphalt was capable of giving.

In 1885 Husnik proposed a modification of the process by which a varnish of great sensitiveness is obtained. The process is described in the *Photographic News* of July 3, 1885.

The bitumen is reduced to a coarse powder, and is dissolved in rectified turpentine. By allowing sufficient time the turpentine will dissolve a large quantity of the asphalt. In three days, if it be frequently stirred, one-third of its own weight.

When the turpentine is thoroughly saturated ether is poured into the solution. The ether at first has the effect merely of thinning it; but when about 2 parts of ether have been poured into 1 part of the bitumen solution, a doughy precipitate begins to fall.

To discover if all the bitumen not soluble in ether has been precipitated, a little ether is placed in a test tube, and a few drops of the mixture of ether, turpentine, and bitumen is poured into this liquid in the test tube. If a precipitate results, it proves that all the available bitumen has not been thrown down; and the addition of ether is continued till, when the test is applied, the supernatant liquid simply mixes with the ether in the test tube.

The solution is allowed to stand for twenty-four hours, when the supernatant fluid is poured away. The precipitate which remains behind amounts to about half the original bitumen. Fresh ether is poured over the precipitate, which is occasionally stirred up during two or three days. This causes it to become considerably firmer on account of the removal of the last trace of the turpentine, and also of the bitumen soluble in ether.

The last portion of ether is retained to be used again, when it is desired to prepare sensitive bitumen again. The precipitate is removed with a bent strip of zinc from the vessel in which it was thrown down; it is placed in a porcelain dish, and is allowed to remain in a warm place for several days, with occasional stirring to secure the complete removal of the ether, when there remains a hard, extremely brittle, glittering black mass, which is readily reduced to powder by hand.

The prepared bitumen is powdered and is dissolved in benzole, the solution being made of such strength that it will flow like collodion, and to each 100 parts of the solution is added $1\frac{1}{2}$ parts of turpentine. The benzole must be quite free from ether. If it is not, the varnish will flow in drops on the plate in place of flowing evenly. This defect can, however, be remedied by adding some chloroform to the varnish.

### *Coating the Plates*

The object in coating a plate with bitumen varnish is to get a very thin but quite even film. The thinner is desirable, because the films at the lines must be rendered insoluble not only on the surface but right through to the plate; and if the film be thick, the exposure required for this will be excessive. It is possible to coat by hand, as a glass plate is coated with collodion; but far the best results will be got by using a "turn-table." This is simply a disc of metal placed horizontally, with an arrangement for clamping a plate down to it, and with appliances whereby it may be made to revolve rapidly on a vertical axis.

The zinc plate is placed on the turn-table, varnish is flowed over it, and by the turning of a handle, the table is made to revolve rapidly. The result is a thin and perfectly even coating of varnish. The thickness of the film should be such that the colour is only a light brown.

### *Exposure and Development of the Plates*

As for all photo-mechanical line processes, it is desirable that the negative show the lines quite clear on a background as opaque as possible. The necessity for opacity is greater in the case of the bitumen process than in that of others. Also, as the contact in the frame is between two ridged surfaces, it is necessary that plate glass be used for the negatives.

The plates should be laid on one side in the dark for some twelve hours so that the films may harden; and just before exposure they are dusted with French chalk to remove any remains of tackiness.

The exposure, if the lines of the negative be quite clear, and if the varnish be prepared as described, will be about fifteen minutes to the brightest sunshine or a corresponding time to diffused light.

To develop the plate a mixture of benzole and turpentine is used. Benzole alone cannot be used as it is so energetic a solvent of bitumen that it would dissolve away even that which has been acted upon by light. Turpentine, on the other hand, acts too slowly.[1] It is well, however, to begin with turpentine, and gradually to add benzole as appears necessary. The plate is simply flooded with the mixture when the parts of the film between the lines begin to dissolve. At the end it may be necessary to assist the action of the solvent by gentle rubbing with a

[1] Bolas, *Cantor Lectures*, "The Application of Photography to the Production of Printing Surfaces and Pictures in Pigment," 1878.

tuft of cotton-wool or a very soft brush; but the greatest care must be taken or the lines may be damaged. If the whole of the ether-soluble bitumen has been got rid of, the solvents should complete development without mechanical aid.

### *Etching the Plate*

The etching is performed just as described in the last chapter, but that the plate may be placed in the first etching bath to receive a very slight etching without the application of powdered resin or bitumen, the thin bitumen coating already on the lines being much more resistant of acid than the mere ink coating given by the transfer process. The image got by the bitumen method is exquisitely clear and sharp if all has been properly performed.

## CHAPTER XXXIX

### PHOTO-MECHANICAL PRINTING PROCESSES—*Continued*

#### *Other Methods of Producing Line Relief Blocks*

*Gelatine and Albumen Etching Processes.*—Either gelatine or albumen may be used in place of the bitumen in the etching process. The results are scarcely so delicate with gelatine or albumen as with bitumen, at any rate with gelatine they are not; but the cheapness and ease of the process, and the comparatively short exposures required, make some prefer the colloid bodies to the bitumen.

So much has already been said of various processes in which gelatine, rendered sensitive with bichromate of potash or ammonia, is used, that the briefest possible description of the use of this substance for producing line blocks will serve.

The plate is thinly coated with a gelatine solution, which may be made up as follows :—

| | |
|---|---|
| Gelatine . . . . . . | 1 ounce |
| Bichromate of potash . . | $\frac{1}{4}$ ,, |
| Ammonia . . . . . | 10 minims |
| Water . . . . . . | 20 ounces |

The plate is thinly coated either by hand or by the aid of the turn-table, an exposure, considerably shorter than would be required for the bitumen process, is given under a negative, and the plate is developed by washing for some time in cold water, then in water at a temperature of about 110°.

The following formula will be found to be a good one for the albumen process:—

| | |
|---|---|
| Dried albumen . . . . | 1 ounce |
| Bichromate of ammonia . . | 80 grains |
| Water . . . . . . | 6 ounces |

Or—

| | |
|---|---|
| White of egg . . . . | 5 ounces |
| Bichromate of ammonia . . | 80 grains |
| Water . . . . . . | 1 ounce |

In the second formula the bichromate is dissolved in the water, and the solution is added to the albumen, which is previously switched.

A zinc plate is thoroughly cleaned, is flooded with distilled water containing a little ammonia, and is then coated with the albumen solution, preferably by the aid of the turn-table. The film should be dried at a moderate temperature, never rising above 120° F., lest the albumen be coagulated.

The exposure required with an albumen film is very short. In fact, if the lines of the negative be quite clear, it may be considerably under one minute in bright sunshine.

The plate is simply developed in cold water, in which the albumen, which has not been acted on by light, is soluble.

When either gelatine or albumen has been used, the etching may go on till a certain relief is obtained, by applying an alcoholic solution of perchloride of iron to the plate. When a certain relief has been obtained, the plate may be inked up with the polished roller, and the etching may proceed as already described; but a method, preferred by some, is to ink up the image before development, much as is done in the case of an ordinary transfer. By careful development the gelatine and albumen, along with the transfer ink, is removed from all parts except the lines. The plate is then etched in the manner already described for a transfer.

### *The "Instantaneous Asphalt Process"*

In this process an attempt is made to combine the advantages of the asphalt and of the albumen process.

A plate is first coated with asphalt, which need not be specially treated to eliminate the ether-soluble portion. A second coating of sensitive albumen is given, the exposure is made, the albumen image is developed with cold water. That which remains on the lines forms a protective film, and the asphalt between the lines may be dissolved away with benzole. There are certain practical difficulties in working this process which, so far as I know, have not as yet been overcome.

### *Processes of Casting from Gelatine Reliefs*

We come now to a brief consideration of a process entirely different from those which we have been considering. It had its origin, I believe, with Poitevin and Pretch. A few words will make the general principle quite clear. If a plate be coated with a film of bichromated gelatine, if this film be exposed under a line negative, and the plate be simply soaked in cold water, but be not developed in warm water, the part of the film which has been protected from light will swell up to a considerable extent, leaving the lines in deep relief. A casting from this swelled gelatine will now give the lines in high relief, and will form a printing block, if it be made in a suitable material, to stand the wear and tear of the printing press or machine. As a matter of fact a casting of such a nature cannot be made *direct* from the gelatine relief, but has to be made in a roundabout way. The following is the method recommended by Bolas :[1]—

Sheet gelatine is prepared by coating a waxed plate with a gelatine solution, and drying it at a moderate tem-

[1] *Cantor Lectures*, "The Application of Photography to the Production of Printing Surfaces and Pictures in Pigment." Six Lectures delivered before the Society of Arts, by Thomas Bolas, F.C.S., London, 1878.

perature. The solution may be made of 1 part soft gelatine, 5 parts water. A sort of dish must be made of glass plate by piling up a rim of wax round the edge, or by some such method, and the solution must be poured in to a depth of about $\frac{1}{5}$ inch. As the coating and drying of such a plate is a very troublesome affair, it is strongly recommended that the sheet gelatine be purchased from Mr. Cornelissen of Great Queen Street, London.

"To make the gelatine solution sensitive to light, it is soaked in a $3\frac{1}{2}$ per cent solution of potassium bichromate till it becomes flaccid, it is then laid on a piece of clean (waxed) glass, and the excess of solution is removed by the application of the squeegee. The plate bearing the wet gelatine is then placed in a warm, photographically dark, place to dry, and when dry it can be easily separated from the glass by raising one corner with a penknife. We obtain, in this way, a flat sheet of sensitive gelatine, having a smooth surface and all ready for exposure under a negative, and the exposure may last from ten to twenty minutes in sunshine, or a correspondingly longer time in the shade."

The sheet is now allowed to soak in cold water for several hours. At the end of this time it will be found that the lines are in deep relief. The film is now squeegeed, exposed side upwards, on a plate of clean glass. It is made surface dry by dabbing with a clean cloth, and a little oil is applied and evenly distributed over the surface. Plaster of Paris is now poured on the film to a thickness of about an inch, care being taken to remove any air bubbles by the application of a camel's-hair brush through the plaster.

When the plaster cast has set quite solid, it, together with the gelatine film, is removed from the glass by a sliding motion. The gelatine film is now removed from the plaster cast by taking up one corner and slowly drawing it away.

We have now a perfect relief block, but one in a substance far too brittle to be printed from. From this block a cast is made in stearine. The plaster cast is heated to a temperature of about 120° F. by dipping it in hot water, and a casting is made on it of stearine, about an inch thick.

When this casting has thoroughly hardened, it is separated from the plaster of Paris, and the surface is powdered over with bronze powder to cause it to become a conductor of electricity. Bolas recommends particularly the powder made by Allan of Mansfield Place, Kentishtown, London, which is specially prepared for electrotyping purposes. The cast powdered with bronze powder is placed in the ordinary electrotyping bath, and when a sufficient quantity of copper has been deposited, the image thus got is backed up with type metal, and is mounted on a wooden block so as to be type high.

As delicate results are not to be expected from the process just described as from an etching process. The boundaries of the lines, in place of being quite sharp, are somewhat rounded. This defect might be got over by exposing the film under a *positive*, and washing out the lines with warm water down to the glass, or to a thin substratum on the glass, and taking a cast from the resulting deep relief plate; but there are many practical difficulties in the way which have not, so far as I am aware, been entirely overcome.

# CHAPTER XL

## PHOTO-MECHANICAL PRINTING PROCESSES—*Continued*

### *Processes for Producing Entaglio or Engraved Line Plates*

In entaglio line processes the lines are cut into the surface of the plate in place of being raised, and the process of printing consists in filling up the lines with ink, or rather covering the whole surface of the plate with ink, wiping that which is not buried in the lines away with a cloth, then bringing down with great pressure on the surface of the plate a sheet of paper backed with some more or less elastic backing. The ink is pulled out of the lines by the paper, giving, of course, a complete image of the engraving or etching.

The advantage of any entaglio process when it is a case of hand-work is very evident. The artist draws or cuts on the surface of the plate the actual lines that are to appear, in place of going through the roundabout process of cutting away everything that is not to appear black, leaving the lines in relief. The consequent freedom of touch is very evident, and especially in the case of etchings. In hand-etching the work is done by a needle either on a thin film of wax on the surface of a copper-plate—the plate being afterwards etched—or directly on the surface of the metal, the work being more analogous to the work of the pencil and the pen than in any other kind of hand-work, producing directly blocks or plates capable of being printed from, except perhaps drawing or transfer paper for the lithographer, which again gives much coarser results than copper-plate etching.

In photographic reproduction processes the entaglio plate has no such advantage over the type block. In either case the artist's work is the same. He draws on white paper with black ink. From this drawing a type block or an entaglio plate may be made at the will of the operator; but there will be but little difference between prints from the two. Both will reproduce all the character of the artist's drawing.

It is true that if sufficient care be given to the printing, and if a very fine quality of paper be used, there will be somewhat more of delicacy in the case of the print from an entaglio plate than in that from a type block. Particularly will this be the case in copies of copper-plate etchings.

In an etching of the kind just mentioned not only does the width of the lines vary, but to a certain small extent the depth or colour of them varies also. It is not an uncommon method for an etcher to put in the main part of his work on wax, to etch the plate, take a proof, and then put in what work appears to be required to modify the effect by the aid of the "dry point,"—that is to say, simply scratching the surface of the copper; these scratchings being of the smallest conceivable depth and holding so little ink that they do not actually print black, but of a gray or brown tint according to the nature of the ink that is used.

There is no process really analogous to this in the case of printing from a type or raised block, although the printer may do something by packing up the back of the paper to different heights, so that the pressure on the surface of the block is different at different places.

In reproducing an etching by photography, it is easy to reproduce the different depths of etching in the original as will be explained.

It may be stated as a general rule that any process which is applicable to the production of a line type block is also capable of producing an entaglio plate if a transparent positive be used in place of a negative. The most suitable metal for entaglio plates is copper. This is scarcely applicable where type blocks are required, as the great depth to which these have to be etched would make the process very tedious with the harder metal ; the amount of etching or biting required for entaglio plates is, however, so exceedingly small, the deepest lines only requiring to be bitten to about $\frac{1}{200}$ of an inch, that this difficulty does not stand in the way.

The process which will be found the most suitable is the asphalt process. As has been explained, it is only in cases where the work is of the most delicate nature that the entaglio process offers any advantage over the type block process, and it is of course not desirable to lose any of the delicacy in the intermediate steps, as may be the case if gelatine or albumen be used, especially the former. The objection to using an engraved plate where a type block will give as good a result, is the comparative slowness of printing from the former, and the fact that it cannot be printed along with type.

If the transfer method be used for the reproduction of a line subject, it is almost necessary to use zinc, which is by no means a very suitable metal for engraved plates. Moreover, where the area of the lines occupies but a small portion of the surface of the plate, certain precautions must be taken. The reason for these precautions is as follows :— If a transfer be made from the positive, which represents such a subject, the greater part of the surface of the transfer will ink up or will retain the ink after development, and on attempting to lay this down on a plate, it will slide over the surface and a smear only will be the result. To prevent this the positive is given a good wide edging of opaque colour, and whenever there is a considerable space between the lines, this is filled up with colour, leaving, however, a space of at least $\frac{1}{16}$ inch between the patch then put in and the line. This results in a transfer having a considerable amount of area without ink, and the image can readily be transferred to a plate. After it has been transferred, and has been strengthened with resin and asphalt powder, the spaces are filled in by hand with asphalt varnish, when etching goes on as will be described. This process is only suitable where a few copies are required.

The etching needed for entaglio plates is so small that it is never necessary to build up the film of asphalt by powdering with resin, etc., and heating. I here assume that the asphalt process—which is the only one really suitable for producing such plates—is used. The plate is exposed under the positive, is developed with a mixture of benzole and turpentine, and is placed at once in the etching fluid.

Nitric acid may be used for etching a plate such as that described, but the following is generally preferred :—

| | |
|---|---|
| Potassium chlorate . . . | 1 ounce |
| Hydrochloric acid . . . | 10 ounces |
| Water . . . . . | 50 ,, |

A solution of perchloride of iron may be used. Such a solution has the peculiarity that, if it be quite saturated, it has little or no etching effect on copper, whereas, if the saturated solution be diluted even slightly, it bites quite readily. It is thus possible to regulate the process to a nicety.

Whatever etching fluid or "mordant" is used, the amount of etching required will be found to be very slight. It can only be determined by experience. Whether it is desirable to stop the process in some of the lines by removing the plate from the bath, rinsing it, drying it, and covering then with bitumen varnish, is also a thing that can be determined only by experience. It is by so doing that the very fine lines of copper-plate etchings already mentioned are reproduced.

If the albumen process be made use of, the etching should be done with an alcoholic solution of perchloride of iron.

In whatever way the plate is etched, the protecting film is cleaned away from it when it comes from the etching fluid, and it is then ready for the copper-plate press.

The process of printing is briefly as follows :—

The plate is inked by rolling over it a roller which carries a thick film of ink on it, or the surface is dabbed all over. In any case, the whole surface of the plate must be covered with ink. The greater part of the excess is removed with a cloth, and then finally with the flat of the hand, which has previously been covered by chalk to prevent the ink from adhering. This last process looks simple when performed by a skilled printer, but really requires much practice. A sheet of paper is laid on the plate, and the two together go through the press, which generally consists of a flat heavy metal plate on which the plate is placed, and a roller which applies pressure to the back of the paper through a pad of blanketing or some other elastic substance. Sometimes a press with a platen coming down with great pressure is used.

## CHAPTER XLI

### PHOTO-MECHANICAL PRINTING PROCESSES—*Continued*

### *Half-Tone Processes*

*Preliminary Statement.*—None of the processes that we have been considering since that of Stannotype is capable of giving a true half-tone. A little consideration will, however, show that, if half-tone be represented by, or translated into, a stipple, lines, or into a stipple which is made up of dots or points, it might be reproduced either by photo-lithography, by the aid of a phototype block, or of an entaglio engraving, there being in such a case no true gradation, but something in black and white which represents it, if we do not look too close.

There are many ways in which a negative or a photographic print may, with greater or less success, be broken up into a stipple, and it is a common thing to point out that if once a negative be so broken up, it may be reproduced by any of the three methods just mentioned, and no doubt this is in a certain sense true. If a pretty wide stipple be got this may be transferred to a stone, and proofs may be pulled from a stone, or it may be transferred to zinc, and the zinc may be etched to produce a type block, or an entaglio plate may be made from it.

But though all this is true, still, if a photograph be rendered in an exceedingly fine stipple—one so fine, say, that it is not visible to the naked eye—a very perfect entaglio plate may be made from it; but if an attempt be made to produce a surface block from it, the fineness of the grain will make it impossible to etch to such a depth as will give a printable block; and if an attempt be made to transfer it to a stone and to pull prints, little more than a smear will be the result.

It may be said generally, that whereas a fairly open stipple is necessary for producing lithographic work, a somewhat finer stipple may be used for type blocks, and a still much finer grain for entaglio plates. The coarse grain applicable to stone *may* be used for type blocks, but as a finer grain is admissible, it is advisable to use this latter. The still comparatively coarse grain applicable to a type block *may* be used for an entaglio plate; but no better result will be got from the plate than from the block, whilst, as a finer grain may be used with the plate, it is certainly advisable to do so.

This being the case, I have decided to treat the rendering of half-tones under three different heads; but here I must state that this part of my work must of necessity be by far the least complete of the whole. The general principles on which half-tone may be rendered have, it is true, been published; but, as a rule, general principles only have been announced, and it may really be said that on these general principles almost less depends than on innumerable details of practice which have either been kept secret purposely, or which could not be published, inasmuch as they are really matters of practice—of manipulative skill—rather than of explicable method. The conjuror may explain the principle of some of his tricks. The sleight of hand, whereby he is able to deceive with them, comes only by a combination of skill and natural aptitude.

Take, for example, type blocks. So far as I know these are produced, with any degree of real success, by three methods only. Dallas has for a long time produced them of excellent quality. In fact, he may be considered in this country as the pioneer of various photo-mechanical printing processes; but his methods have never been divulged. The Meisenbach process is greatly worked, both by the firm bearing the name and others; but it is almost certain that many unpublished points of detail are essential to the wonderfully fine results that are got by some of those who work it. Of the Ives process almost the same may be said, whilst it may further, I believe, be stated that in its later developments certain appliances used by the inventor and specially manufactured for him are not purchasable by the public. The process of Ives is to my mind the most scientific of any grained half-tone process, yet others practically the same have failed in less skilled hands than those of Ives.

I say that the three processes above mentioned are the only ones which are, to my knowledge, at all extensively used, yet other processes have been published, of which it might, I think, certainly be said that they contain the germs of as great success as do any of these three; but these processes have fallen quite flat for the want of that determined work and constant attention to a thousand small details that are necessary for success with a photo-mechanical process.

I think it might in fact be said that, in the matter of photo-mechanical processes,—perhaps particularly of type blocks,—the nature of the process is a smaller factor to determine success or failure than the worker of it. An intelligent worker, giving the time and attention necessary to work up a process, will get good results with any out of a dozen or two; but such instruction as can be given in writing will be of but little aid. One without intelligence giving great time and care to working up the matter will fail with whatever process he attempts, and to him, too, written instructions will be of little avail.

It is needless to say that a thorough knowledge of the manipulations of line processes is of the greatest advantage to one who intends to attempt half-tone processes.

# CHAPTER XLII

## PHOTO-MECHANICAL PRINTING PROCESSES—*Continued*

### *Methods of Obtaining Half-Tone in Photo-Lithography*

*Asser's Process.*—This process was one of the first that gave results of any degree of success in photo-lithography. The following is a brief description of the manipulation :—

Unsized [1] paper of an even texture is taken. A starch solution, of somewhat less thickness than is commonly used for mounting or for such like purposes, is made up, and one side of the paper is thinly coated with this by the aid of a sponge.

The paper is now dried, and is floated film side upwards on a saturated solution of bichromate of potash till the colour indicates that the salt has penetrated the starch film through the paper. The sheet is then dried in the dark.

The paper, after it has been treated as just described, is sensitive to light. It should not be kept for longer than a day or two before it is exposed. The negative for this process need not be reversed. It should be of good quality and brilliant. The exposure may be judged of by examination, being stopped when the finer details of the lights show themselves. The image is of a brownish colour.

[1] Bolas recommends the use of blotting-paper, but the writer has found it very difficult to work such except in very small sizes on account of its extreme softness when wet. Rives's paper may be soaked in very hot water to remove any size it may contain, and will be found to work well.

The sensitive tissue is now laid film side upwards on the surface of a bath of cold water till the bichromate is all washed out of the film through the paper. When the yellow colour has disappeared, the paper is dried first between blotting-paper and then in the open air.

The paper has now to be heated to a very considerable extent. It is difficult to give precise directions as to how much it should be heated; but it may be said that the heat should just be short of what will make the paper brittle or to discolour it. The heating may be done in front of a clear fire if the operation be performed with care. Asser himself, I believe, advised that the sheet be laid on a slab of marble that had been heated. Bolas advises the application of a hot iron to the back of the sheet, and the writer has found this to be a quite satisfactory plan. The effect of the heating is to cause the sensitive starch which has been acted upon by light to absorb lithographic ink with great avidity.

The image is now damped by laying it for some time between sheets of wet paper under some pressure when it is ready to be inked up. It is laid on a piece of plate glass—the image upwards of course—the surface is blotted off with a piece of perfectly dry blotting-paper, and a roller charged with ink of medium thickness is passed over the surface. A granular image is thus produced, which may be transferred to a stone in the following manner :—

Weak nitric acid is made up as directed for etching a lithographic stone (Chapter XXXIV.). A polished lithographic stone is warmed, as also described in that chapter. The inked Asser transfer is now damped on the back with the nitric acid mixture either by the aid of a sponge or by floating it, it is laid on the warm stone, and the rest of the process is performed exactly as described for an ordinary transfer. The stone is then printed from in the usual manner.

It will be understood that a much higher degree of skill in printing, and a greater accuracy in the press, are required when a half-tone subject is being treated than in the case of a line subject of the ordinary character.

*Transfer from Collotype Plate*

An examination of photo-lithographic prints in half-tone which, in commercial practice, have been most satisfactory, can leave very little doubt that the grain which they show is one obtained by the reticulation of gelatine. Is, in fact, the same grain as is to be seen in collotype, except that it is more open than it is generally to be seen in the case of the latter process, in which the attempt is always made to keep the grain as fine as possible, and in which, in practice, it is kept so fine that it would give no satisfactory results if transferred to a lithographic stone.

Pretch, at a very early date, took advantage of the reticulation which is now taken advantage of in the collotype process, for the purpose of producing, by casting from the reticulated surface, type blocks representing half-tone, and it was a very small step to ink up the reticulated film to make a transfer from it to a stone, and to print from the stone. It was, nevertheless, only quite recently that the process became one of at all general applicability. In this country the process has been most successfully worked by Messrs. Sprague and Co.

Unfortunately the details of the process as worked commercially have not been divulged, but it may be stated that, if an image, such as is produced in collotype work, but with a very open reticulation, be got, there need be no difficulty in making a transfer from this to a stone, and in printing from the stone. Fortunately, too, there is no need to take the many precautions which are necessary in the case of collotype surfaces from which a great number of prints have to be taken, to secure firm adhesion of the film to the support. These precautions, or at least some of them, tend to a fine grain.

The following formula, which is due to Bolas, has been found to give a very open grain :—

| | | |
|---|---|---|
| Gelatine | . . . . . | 6 parts |
| Water | . . . . . | 60 ,, |

| | |
|---|---|
| Bichromate of ammonia[1] . . | 1 part |
| Chloride of calcium . . . | 2 parts |

A plate is prepared as in Husnik's process of collotype, described in Chapter XXXVI., but a considerably thicker coating is given than would be considered desirable for collotype. The film is dried at a high temperature, say 140° or 150°. The exposure of the back of the plate to light is omitted.

The plate is developed in the usual way and is inked up. An impression is taken on transfer paper, and is transferred to a stone in the usual way. Probably a better transfer will be obtained if some half dozen copies be first pulled on plain paper.

It will be seen that if the process be performed as described, a reversed negative will be required as in the case of collotype printing; whereas, if the collotype surface were applied directly, an ordinary negative might be used.

Various methods have been suggested to enable the image to be directly transferred to the stone, a flexible support being the only essential. The use of gelatine skins, as in the heliotype process, and the use of a sensitive film supported on paper have been recommended. The following plan has been found to work experimentally :—

A glass plate, at least half an inch larger each way than the desired print is taken. On this is laid a piece of wet paper, which is fixed down to the glass by a strong alcoholic solution of gelatine (see Chapter XXXII.) at the edges. On the paper is spread the solution given above, which is used to the extent of about 2 ounces per square foot. The plate is then placed horizontally in the drying box, which is raised to a pretty high temperature (say 140° F.). It is, when dry, exposed under a negative,

[1] This is the quantity given by Bolas, who has worked the process much more than I have; but I must state that I have succeeded better with a very considerably larger quantity of bichromate of ammonia.

developed,—without exposure from the back, or the use of an alum bath,—and dried.

The paper is now removed from the plate by cutting within the glued margin with a sharp knife. It is damped and is inked up, after which the image is transferred to a stone by placing the flexible film thereon, and passing the two through the press.

Since the above was written, J. Husband, Sergeant-Major, R.E., has published in the Journal of the Photographic Society a process for "Practical Lithography in Half-Tone." This is, so far as I know, the first time that a process has been published with all working details, and the publication is of great value. I quote it in its entirety here:—

"*Description of Husband's Papyrotint Process*

"This process has been named papyrotint, being a modification of Captain Abney's improved method of photo-lithography, named papyrotype. It is specially adapted for the reproduction of subjects in half-tone, such as architectural drawings in monochrome, or subjects from nature, and it is inexpensive. Its advantages over other methods of half-tone photo-lithography are, that a transfer can be taken in greasy ink, for transfer to stone or zinc, *direct* from any negative, however large, without the aid of a medium, the grain or reticulation being obtained simply by a chemical change. The transfer paper being in direct contact with the negative, the resulting prints are sharper than by those processes where interposed media are used; whilst the same negative will answer either for a silver print, platinotype, or a transfer for zinc or stone. The advantage of being able to use a non-reversed negative is very great, now that gelatine plates have so largely superseded those made with collodion.

"The method of manipulation is as follows:—Any good surfaced paper is floated on a bath composed of—

| | | |
|---|---|---|
| "Gelatine (Nelson's flake) . . | 8 | ounces |
| Glycerine . . . . . . | $1\frac{1}{2}$ | ,, |
| Chloride of sodium (common salt) . | 2 | ,, |
| Water . . . . . . | 50 | ,, |

Great care should be taken that the solution is not overheated, and that the paper is coated without bubbles. It is then dried in a temperature of 60° F. The paper will take about ten hours to dry, and in this state will keep for years. When required for use, it should be sensitised by floating, or immersing, in a bath of—

| | | |
|---|---|---|
| "Bichromate of potash . . . | 1 | ounce |
| Chloride of sodium . . . | $\frac{1}{2}$ | ,, |
| Ferricyanide of potassium . . | 100 | grains |
| Water . . . . . . | 30 | ounces |

This need not be done in the dark room, as the solution is not sensitive to light.

"The paper, after sensitising, is dried in a temperature of 70°, and in a dark room. When dry, it is exposed under any half-tone negative, in the ordinary printing frame. It is preferable to print in sunlight, and, for negatives of medium density, an exposure of three minutes is required; but the exposure will vary according to the density of the negative. The correct time of exposure can best be judged by looking at the print in the frame. When the image appears on the transfer paper a dark fawn colour on a yellow ground, the transfer is sufficiently printed. It is put into a bath of cold water for about ten minutes, until the soluble gelatine has taken up its full quantity of water; then taken out, placed on a flat piece of stone, glass, or zinc-plate, and the surface dried with blotting-paper.

"The action of the light has been to render the parts to which it has penetrated through the negative partly insoluble, and, at the same time, granulated. A hard transfer ink is now used, composed of—

| | | |
|---|---|---|
| "White virgin wax . . . . | $\frac{1}{2}$ | ounce |
| Stearine . . . . . . | $\frac{1}{2}$ | ,, |
| Common resin . . . . . | $\frac{1}{2}$ | ,, |

These are melted together in a crucible over a small gas jet, and to them are added 4 ounces of chalk printing ink, and the mixture reduced to the consistency of cream with spirits of turpentine. A soft sponge is saturated with this mixture, and rubbed gently over the exposed paper (in this stage the nature of the grain can be best seen). An ordinary letterpress roller, charged with a little ink from the inking slab, is then passed over the transfer, causing the ink to adhere firmly to the parts affected by the light, and removing it from the parts unacted upon. It will be found that with practice, rolling slowly and carefully as a letterpress printer would his forme, the ink will be removed by the roller according to the action that has taken place by light, leaving the shadows fully charged with ink, and the high lights almost clear, the result being a grained transfer in greasy ink. The transfer is next put into a weak bath of tannin and bichromate of potash for a few minutes, and when taken out the surplus solution should be carefully dried off between clean sheets of blotting-paper. The transfer is hung up to dry, and, when thoroughly dry, the whole of the still sensitive surface should be exposed to light for about two minutes. A weak solution of oxalic acid should be used for damping the transfer (about 1 in 100), and this should be applied to the back of the transfer with a soft sponge. After it has been damped about four times, it should be carefully put between clean sheets of blotting-paper, and the surplus moisture removed. A cold polished stone is then set in the press, and after everything is ready, the transfer is placed on the stone and pulled through twice. The stone or scraper is then reversed, and the transfer is again twice pulled through. A moderate pressure and a hard backing sheet should be used, care being taken not to increase the pressure after the first pull through. The transfer is taken from the stone without damping, when it will be found that the ink has left the paper clean. Gum up the stone in the usual way, but if possible let the transfer remain a few hours before rolling up. Do not wash it out with turpentine, and use middle varnish to thin down the ink.

"It should have been mentioned that varying degrees of fineness of grain can be given to the transfer by adding a little more ferricyanide of potassium in the sensitising solution, and drying the transfer paper at a higher temperature, or by heating the paper a little before exposure, or by adding a little hot water to the cold-water bath, after the transfer has been fully exposed; the higher the temperature of the water the coarser the grain will be. The finer grain is best suited to negatives from nature, when a considerable amount of detail has to be shown.

"The coarse grain is best for subjects in monochrome, or large negatives from nature, of architecture, etc., where the detail is not so small. Even from the finer grain several hundred copies can be pulled, as many as 12,000 having been pulled from a single transfer, and this one would have produced a great many more if required."

# CHAPTER XLIII

## PHOTO-MECHANICAL PRINTING PROCESSES—*Continued*

### *Methods of Obtaining Half-Tone in Phototype Blocks*

An image with a grain suitable for reproduction by phototype having been obtained, the type block may be made by exposing, under a negative taken from this image, a zinc plate coated with bitumen, developing and etching, by transferring a print on transfer paper taken from this negative to a zinc plate and etching, or by using the image, if it be of the nature of collotype, as a matrix, from which a relief block may be cast as in the Pretch process.

These methods of producing type blocks for line subjects have already been described, and of their application to half-tone subjects it should be enough to say that the manipulations are similar.

*Asser's Process*, described in the last chapter, has been used for the production of type blocks, as explained by Bolas; the image in grain being transferred to a zinc plate and this latter being etched; but the writer is not aware that the process is worked commercially.

*By the Collotype Process* a grain suitable for reproduction by type blocks may readily be produced. The grain may be made somewhat smaller or closer than is admissible for photo-lithography. Dallas's tint blocks would appear to owe their grain to a collotype film, but it is impossible to say whether the block is produced by transfer or by reproducing the reticulated surface of the film by electrotype.

## *The Use of a Grained Screen for Producing a Half-Tone Type Block*

As far back as 1866 Messrs. E. and J. Bullock patented a method of interpreting half-tone by a grain, in which they superposed, on a transparent positive, a grained screen, and took a negative from the two together, this negative of course showing, as well as the image of the transparency, the grain of the screen.

It is difficult to account, by any theory, for the fact that the mere *breaking up* of an image by introducing a grain gives the effect of half-tone by a process in which any one point must be represented by either black or white; but this subject has already been touched on in the introductory chapters. Probably the success of the process depends on certain factors—diffraction of light, perhaps, for example—which have not yet been considered in connection with it. At any rate we have nothing to do but to accept thankfully the fact that the result *is* a very fair representation of half-tone.

The principle of Bullock has been re-patented times out of number, but the only thing in the way of a novelty which has been introduced is the modification of Meisenbach, who introduces an arrangement whereby the grained screen, during the exposure for the reproduction of the final negative from the transparent positive and this screen, is slightly moved once or oftener so as to still further break up the grain. At first sight it would appear that such a movement was the one thing necessary to make the reproduction of half-tone as a black and white grain absolutely hopeless; but here, again, if we can judge by some of the effects obtained by the Meisenbach process, theoretical reasoning is at fault.

There are two ways whereby the grain is principally produced: one is the dusting of powdered asphalt on a plate of glass and the warming of this till the powder adheres to the glass. A method of evenly powdering a surface with asphalt will be considered in the next chapter. Another way, and the one most frequently used, is the photographing of something of the nature of netting. Actual wire-netting may be used, or any system of black cross lines on white paper may be photographed. If netting be used, it is photographed against a white background, which may be the sky. By using this method it is, of course, possible to produce a grain of any desired width or number of spots to the inch. A wet plate will be found the best for producing the grained plate.

Processes have been patented in which an actual fine netting of thread is used in contact with the transparency in place of the photographic netting, but it is doubtful if good results can thus be got unless the transparency be made of much larger size than the desired photo block, as the grain will be far too coarse even if the finest netting be used.

The following is a brief description of the manipulations of producing a type block by the method indicated, the grained screen having once been produced.

A transparency is made by contact from the original negative. In contact with the transparency is placed the grained screen, the two being placed film to film. A copy is made from these in the camera in the usual way in which negatives are made from transparencies, or transparencies from negatives, the transparency being placed next the camera, and therefore the film side of this being away from the camera.

From the negative thus got an image is printed directly on a zinc plate, on a film of bitumen, or on a piece of sensitive transfer paper, the image being in the latter case transferred to the zinc plate. Etching is then performed as already described.

I should here say that when it is a case of etching an image in grain, it is necessary to begin with very weak acids and to exert the utmost care throughout.

I do not know precisely what contrivance is used by the workers of the Meisenbach process for shifting the position of the screen during the exposure, but various mechanical arrangements whereby this might be done will suggest themselves to any intelligent worker.

### *Woodbury Process*

"Woodbury exposes his ordinary relief [1] under a transparency with a piece of network interposed, the effect of this being to produce a decided grain all over the high portions of the resulting relief and no grain over the deep parts, intermediate portions being grained to an intermediate extent." [2]

The relief thus obtained is inked up, a transfer is taken from it and is laid down on a zinc block, which is then etched. The network need not be actual netting, but may be a transparent positive of any netlike pattern on a collodion film. It may thus be made as fine as is desired.

### *Process of Ives and Analogous Processes*

The process of Ives is a very beautiful one, but is, at present at any rate, scarcely open to the public. The following is a description of it: —

In general principle the process depends on the pressure of a half-tone relief on a surface more or less compressible, and consisting of a series of slight eminences forming a grain, as, for example, paper having a surface something like bookbinder's cloth. The eminences are flattened out in proportion to the height of the relief, and if by any means the *flattened* portions be inked, the result is a grain representing a half-tone on account of the greater size of the dots or grains in the darker than in the lighter parts. In fact, in the deepest shadows the eminences are entirely flattened, giving an even black tone, in the brightest lights they are not touched at all.

Ives at first used a Woodbury relief, but afterwards he used a gelatine relief (undried) from a transparency, and made a plaster of Paris cast from this (see Chapter XXXIX.). A comparatively thin film produces sufficient relief when it is not necessary to resort to drying, and therefore a "swelled gelatine relief" is much more easily produced than a Woodbury relief.

[1] Chapter XXXIII. p. 254.

[2] Bolas, *Cantor Lectures.*

A rubber surface, which has been formed into a series of V-shaped grooves and ridges, is inked, and is pressed on to the cast. The elastic surface does not touch the hollows. The V ridges are quite flattened out in the highest parts of the relief, producing a continuous black, and everywhere between the deepest and the highest parts they are flattened to a different degree, so as to give an even stipple. The image thus got is transferred to zinc and is etched.

*Zuccato's* method may be described as a modification of Ives. It is an exceedingly ingenious one. I do not know whether the use of the lead blocks to be described hereafter is open to the public; but if it is, I should put down the process of Zuccato as about the most likely of any to be useful to one taking up the production of type blocks for the first time.

The surface of a piece of type metal is formed into minute pyramids by planing V-shaped grooves across it in two directions.

A Woodbury relief is produced, the type metal plate is thinly inked, a piece of very thin paper is placed on it, and this is pressed with great pressure between it and the Woodbury relief. The result is that the highest parts of the relief—representing the shadows of the picture—flatten out the pyramids till they are obliterated; they are not touched by the deepest parts of the relief, intermediate parts flatten them to intermediate extents, and a half-tone image is the result on the paper, the half-tone being obtained by dots of varying sizes. This image may be transferred directly to a zinc plate, or may be copied in the camera, a transfer may be made and transferred to the plate, which is then of course etched.

There are many other methods of producing half-tone type blocks, but I think I have mentioned the principal.

It is to be observed that much may be done in the etching to help up a type block. Thus a solid shadow may be made anywhere it is required—or even a line if it be thought useful—by treating with bitumen varnish, whilst a high light may be put in by scraping away the protective coating.

# CHAPTER XLIV

## PHOTO-MECHANICAL PRINTING PROCESSES—*Continued*

### *Methods of Obtaining Half-Tone in Entaglio Plates*

It is to entaglio plates that we have to look for the finest results in photo-mechanical printing. Collotype and even type blocks give results which are in their way excellent, and which are useful for many purposes; but they fall very far short of the results of certain entaglio processes which compare favourably in effect with the very finest hand-engraving, whilst they have the advantage of the accuracy of a photograph.

In prints from type blocks there is always some want, the grain is too conspicuous, there is a want of half-tone, or of intensity; but with proofs from entaglio plates it is otherwise. The utmost boldness is obtainable, the gradation of tone is perfect, and although, in a certain sense, a grain or stipple is essential, this may be so fine as to be quite imperceptible. In fact, the slight roughness or removal of polish given by the biting of copper by an etching fluid is enough to give the necessary grain. This was all that gave the grain to the greater number of the engraved plates which were produced by Fox Talbot, and from some of these prints were pulled almost as good as the best that have been made. Since then, however, the best results have been got where some special means have been used to get a stipple somewhat more marked than that got by the mere biting of the plate.

A brief description of the principles involved in various entaglio processes has been given in the second chapter, and it is unnecessary to say anything more of those which are not at the present day practically worked. Unfortunately not very much can be said even of those which have, because, as in the case of the production of type blocks, the greater number of workers of processes have kept secret those small details of practice which make success possible in place of failure, even when they have published the general principles of the processes, which they have not always done. Again, where details have been published, they, with the processes, have generally been patented, and they are therefore not open to the public.

Several processes for the production of entaglio plates are open to the public, and fortunately of one of these, and that one which gives results equal to any, working details have recently been published. It must not, however, be expected that even when details are published success in working an entaglio half-tone process can be gained but by long and patient practice. The manipulation of a plate by such a process is a matter of the utmost delicacy at every turning.

Before describing any processes used exclusively for the production of half-tone entaglio plates, I should mention that every process used for obtaining half-tone in type blocks has probably been at one time or another applied to the production of the same in entaglio copper-plates, and that at the time the Meisenbach principle is used for the purpose. The writer has seen very successful prints from copper-plates, in which the grain was produced by this process, made by Mr. E. Edwards; but he cannot help saying that he considered them to fall very far short of prints from plates produced by the same operator by a different process (Klie's). A great deal, however, depends on taste.

### *Woodbury's Process*

Woodbury, as was usual with him in all photo-mechanical processes, was to the front with a really practicable engraving process. The general principle of his process has been described in the second chapter. It will be understood since the method of getting a Woodbury relief has been described. Such a relief is used, powdered glass, or some other gritty powder being incorporated with the gelatine. The relief is then pressed into a sheet of lead. Lead is too soft to print from, and the surface is therefore reproduced in copper. This is done by depositing copper on the lead plate by the electrotype process till a copper film of sufficient thickness to be manageable is obtained. On this, in its turn, is again deposited a copper film.

It is said that the magnificent photo-gravure prints issued by Goupil and Co. of Paris are produced by this process. They have never been excelled by anything of the kind; but it is said that a great deal of hard work is necessary before the plates are fit to be printed from.

### *Klie's Process*

By this process the very finest results have been got. It is worked with great success in Glasgow by Annan Brothers; in Brooklyn, United States, by Mr. E. Edwards, and by various operators on the Continent. Some of the results obtained by this latter the writer considers to be at least equal to anything that has been done in the way of photo-mechanical reproduction. Various details of working have been published, the most complete having appeared in the *Photographic News*.[1]

The following are the general principles of the process:—

A copper-plate is covered with a fine powder of asphalt, which is caused to adhere by heating the plate, on this plate is developed a carbon *negative*, made by exposing a piece of tissue under a positive, and the whole is placed in an etching fluid. The powdered asphalt gives the grain, and the carbon negative permits the etching fluid to bite to a depth inversely proportionate to the thickness of the gelatinous film. It will be seen that the process differs

[1] *Photographic News*, January 28, 1887.

from Talbot's merely in the introduction of the asphalt powder to produce a grain.

The practical details of the process are as follows :—

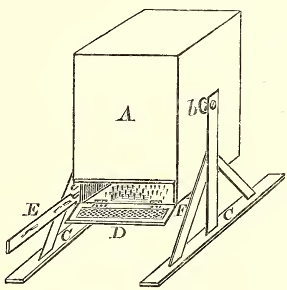
The copper-plate is polished and is cleaned with whiting mixed to about the consistency of cream, and with some caustic soda added.

The cleaning must be continued till, when the plate is rinsed with water, the water spreads evenly over it, not running in patches. This indicates that the last trace of the oil used in polishing has been got rid of.

The plate has now to be covered with a fine powder of asphalt. There are various ways of doing this. In any case the asphalt must be first of all reduced to a fine powder. Mr. Ernest Edwards has told me that he covers his plates with powder simply by holding them in a shower of the dust allowed to fall through the air.

The following is the description given in the *Photographic News* of the more elaborate method of Delechamp's—a box revolving on an axis is used :—

"To make such a one, get a well-seasoned wooden box,




about 4 feet high, dove-tailed and joined without crevices, including the top, which must be made a fixture; the internal dimensions of the bottom must be large enough to carry the largest sized plate to be etched, and the inside had better be French-polished, or papered with a surface-glazed paper. At one of the sides close to the bottom make a narrow door, hinged to the bottom of the box. It should be framed and panelled to prevent its warping.

"To ensure the operator from being 'powdered,' nail strips of sheet-rubber round the inside of the door, so that it will shut up nearly hermetically; use a bar with a stout spring or screw to close it, as in a copying frame, then a few double-pointed nails driven into the base upon which the powder is settling will complete the affair, with the exception of the axis, which will be better understood from the foregoing sketch."

To powder the plate the following operations are gone through :—

"A quantity of finely powdered asphalt or resin having been placed in the box, the door is closed tightly, and it" (the box, not the door) "is turned over two or three times to shake up the powder. After the lapse of a minute or two, to allow the coarser particles to settle down, the door is opened and a previously cleaned plate is placed therein" (in the box, not the door), "poised on the points of the nails (which should project 1 inch from the bottom and all be equal in height), and the door is closed. Shoot the bolt F to keep the apparatus steady after having revolved it.

"The degree of granulation is entirely in the hands of the operator, as the longer the plate remains in the box the greater will be the quantity of powder deposited, and the finer will be the resulting grain, as there will be less surface exposed to the action of the mordant" (etching fluid).

The plate is now heated in the flame of a Bunsen burner till the dull surface of the asphalt changes to a glossy coating; at this moment the plate is removed from the flame.

A transparent positive is made on glass in any of the various ways by which such positives can be produced. This positive must be reversed. It can therefore be most conveniently made by the carbon process (see Chapter XXVII. p. 214). A piece of ordinary carbon tissue is exposed under this positive, is squeegeed on to the copper-plate on which has been laid the grained asphalt surface, and is developed in the usual way. The colour of the tissue is of no consequence, but it is advisable that there be but little pigment, so that the progress of the etching can be seen through the film.

The etching fluid is a solution of perchloride of iron. As has been already stated, such a solution acts less vigorously when saturated than when diluted. Four solutions are made up; the strongest is made so that it has a specific gravity of 40° Bennie, the weakest so that it indicates 30°, and the others of intermediate strength. In each solution a strip of copper is placed till the solution perceptibly changes colour. If this precaution be omitted the solution may act unevenly.

The edges and back of the plate are varnished. The fluid may be kept on the plate either by building a wall of wax round the part that has to be etched, or by flowing it (the fluid) over the plate in a dish.

The solutions are all used at a temperature of about 70° F.; the strongest first, and after that the weaker ones in succession. The action can be watched through the film, and experience will show how long to let the various solutions act.

The gelatinous image is removed with caustic alkali, and the asphalt with turpentine. If the shadows be not considered deep enough, the high lights and half-tones may be protected by going over the plate with a polished roller, and the shadows may be re-etched (see Chapter XXXVIII.).

### *The Waterhouse Process*

Sand is waxed by placing it in an iron pot, heating it, placing some wax amongst it, removing from the source of heat, and continually stirring during cooling.

A carbon print is produced on a surface of silvered copper by exposing a piece of tissue under a reversed negative, and developing it on the plate. The plate after development is placed in a falling shower of the waxed sand. It is dried, and the sand is brushed away. Small pits are left, forming a "discriminating grain." The surface is blackleaded, and a cast is made from it in an electrotype bath. This cast is the printing plate.

### *Sawyer's Process*

In this process carbon tissue is used in which the pigment is replaced by powdered graphite. The developed picture is thus a conductor of electricity, and a cast can be made direct from it by electrotype. All that has been published about the process can be read in the *Transactions of the Photographic Society of Great Britain.*[1]

### *Obernetter's Process*

The principle of this process has already been described, but the writer is unable to give working details at the time of writing. The process is an exceedingly ingenious one, and likely, in the hands of skilled workers, to be very successful.

[1] See *Journal of the Photographic Society of Great Britain* for November 1885.

# CHAPTER XLV

## THE PRODUCTION OF TRANSPARENCIES OR TRANSPARENT POSITIVES

THE subject of transparent positives has been incidentally mentioned more than once in the foregoing chapters, but I think a few words on the subject generally are called for in a book on Printing Processes.

Transparent positives are generally produced for one of three different purposes, either as an intermediate step in some process—as, for example, the powder process—as pictures to hang against windows or in such-like positions, or for lantern shades. The qualities necessary for these different purposes vary somewhat.

Thus when a transparency merely serves an intermediate purpose, it is generally necessary to secure all the *high light details* in great strength, and it is almost impossible to do so without giving such an exposure that even the highest lights are slightly veiled. This necessitates slightly denser shadows than would be necessary with perfectly clear high lights, so as to retain contrast, and, in fact, a transparency used merely as a means for reproduction of negatives or positives should, as a rule, be generally somewhat darker than is pleasing to the eye.

In the matter of a transparency for decorative purposes, we must be guided entirely by taste. The transparency is in this case the finished picture, and should be made, as regards density, colour, and so forth, as the artistic knowledge of the operator dictates

In transparencies for the lantern the matter is slightly different, and for the following reasons :—A veil in the high lights degrades the picture on the screen to a much greater degree than it does the slide itself merely looked on as a transparency; again, the contrast on the screen always appears greater than that of the slide looked at against a light as a transparency. For these reasons it is necessary to secure, in lantern slides, the most perfect transparency of high light and the extremest delicacy of image. Any process that will produce a good lantern slide is certainly good enough for the production of a transparency for any purpose. I therefore say a few words first on the methods applicable to the making of such slides.

Various of the processes already described are well suited to the production of lantern slides, notably the *Carbon process*, the *Woodbury-type*, and the *Stannotype* processes, an essential condition for success with the two last-mentioned processes being the use of glass that is quite flat.

The *wet collodion* process and the *collodio-bromide* are both exceedingly useful for lantern-slide work, but it is beyond the scope of this work to consider them in detail.

*Gelatino-chloride plates* have recently become very popular for lantern-slide work. Such plates are now a recognised commercial article. The exposure required by them is considerable, amounting to many hundred times that necessary for gelatino-bromide plates. By contact a second or two diffused daylight may be given, or a few inches of magnesium ribbon may be burned at a distance of a foot or so—less or more, according to the density of the negative and the colour of transparency wished—from the negative. The exposure to lamplight is very long, amounting to perhaps quarter of an hour at a foot from an ordinary burner. It is, however, quite within reasonable limits if a bright light such as an albo-carbon burner or a duplex paraffin lamp be used.

A very great range of colour is obtainable with gelatino-chloride. It is possible to get anything from an engraving black to claret colour according to exposure and development.

The developer is ferrous oxalate, ferrous citrate, or a mixture of the two. With a comparatively short exposure and ferrous oxalate a black colour is got, with a long exposure and strongly acid ferrous citrate a red colour, and anything between these two limits with intermediate exposures and mixtures of these developers. Instructions for compounding the developer in the various ways issued are sent with the plates.

The films of gelatino-chloride plates are very transparent, and on account of their comparative insensitiveness a good deal of artificial light may be used in development, and it is therefore easier to regulate the density than in the ordinary bromide plates.

Any of the processes before mentioned may be used for making ornamental transparencies. But for transparencies required for mechanical work a somewhat prolonged exposure would be generally advisable.

Certain paper processes give very good results in ornamental transparencies of large size. Thus if a print be made on gelatino-bromide paper, a somewhat longer exposure being given than for an ordinary print, and if the finished positive be treated by smearing the back of it with oil-vaseline, be laid on one side for twenty-four hours, and the excess of vaseline be then removed with a clean cloth, a very effective window transparency will result.

Even common albumenised paper sensitised in the usual way may be used for such transparencies, the *back* of the paper being placed in contact with the negative, and exposure being continued till the desired effect is seen on looking *through* the paper.

The slower makes of ordinary gelatino-bromide plates will make quite presentable transparencies if developed with a considerably diluted and well restrained ferrous oxalated developer.

# CHAPTER XLVI

## PROCESSES FOR COPYING PLANS OR OTHER DRAWINGS IN BLUE

THERE are certain processes which are almost exclusively employed for the copying of plans or other drawings, and which are most useful for such purposes. In the case of one of them, which is very simply worked, the copy is in the form of a negative,—that is to say, it shows as white lines on a dark blue ground. For most purposes such a drawing is practically as useful as a positive drawing. If, however, a positive drawing—one that is showing dark blue lines on a white ground—be desired, the second or third of the three processes to be described must be used.

The papers for either of the processes may be purchased ready prepared, and I may say that it will probably be found convenient so to purchase them unless work be done on a very large scale, and possibly even then, at any rate in the case of the positive processes.

For whatever process is used it is desirable that the drawing to be reproduced be traced on tracing paper, or better, tracing cloth, of as transparent a nature as possible, with ink as opaque as possible. A little yellow colour may with advantage be added to the Indian ink used for such tracings.

Where the process is regularly used, in workshops, etc., it is a common practice to omit the inking in of the drawing on drawing-paper, and to make a tracing of it on very transparent tracing cloths to serve as the standard drawing to be kept in the drawing office. This tracing then serves for the reproduction of blue copies for the shop, etc.

The best effect is produced if all shading (to indicate sections, etc.) be done with inked lines; but for rough work, as, for example, for detail drawings for shop use, colour may be used in the usual manner.

Although the best results are got by copying tracings, it is possible to get quite useful results from drawings even on thick drawing-paper, a very long exposure being given to compensate for the opacity of the paper.

By using the ordinary process—which gives a *negative* from a *positive drawing*—a positive is of course obtainable from an ordinary negative, and the blue colour of such positive is very effective for certain half-tone subjects; for example, some sea-scapes. The prints, unfortunately, have generally a somewhat "sunk-in" appearance; but the writer's attention was attracted by some very brilliant blue prints in the store of Mr. Sam C. Partridge of San Francisco, and was told that the brilliant surface was obtained by the use of encaustic paste (see Chapter XXXII. on Mounting Prints). The process has the advantage that any kind of paper may be used with it.

### *The Ordinary "Blue Process"*

To produce paper for this process, the following solutions are made up:—

A.

| | |
|---|---|
| Potassium ferricyanide (red prussiate of potash) | 5 ounces |
| Water . . . . . . . . | 20 „ |

B.

| | |
|---|---|
| Ammonia citrate of iron . . . . . | 5 ounces |
| Water . . . . . . . . | 20 „ |

The two solutions are kept separately. When paper is to be prepared equal parts of each are taken, and paper is coated with the mixture simply by laying it on a flat board, and sponging the liquid over it with a clean sponge. As already mentioned, any kind of paper may be used, but for copying drawings a thin, smooth drawing-paper will be found to serve best. It is not necessary that the coating of the paper appear quite even so long as no parts are left bare.

The paper is hung up to dry and may be used at once, or at any time within a few days of its manufacture. The exposure is long, five or six times that necessary for a silver print. Exposure is continued till all the print but the lines assume a bronzed appearance, or, in fact, as long as possible without much discoloration of the lines.

The print after exposure is dipped in water, when the bronzed appearance turns to a bright blue, and the lines clear up. It is then washed till the water that comes from it is colourless, when it is finished.

It will be observed that drawings and tracings must be placed with their *backs* in contact with the paper, otherwise the images will be reversed.

### *Blue Positive Processes*

#### *Pizzighelli's Process*

A.

| | |
|---|---|
| Gum-arabic . . . . | 3 ounces |
| Water . . . . . . | 15 ,, |

B.

| | |
|---|---|
| Citrate of iron and ammonia . | $1\frac{1}{2}$ ounce |
| Water . . . . . . | 3 ounces |

C.

| | |
|---|---|
| Ferric chloride . . . . . | 1 ounce |
| Water . . . . . . | 2 ounces |

D.

| | |
|---|---|
| Potassium ferrocyanide (yellow prussiate of potash) . . | 2 ounces |
| Water . . . . . . | 20 ,, |

E.

| | |
|---|---|
| Hydrochloric acid . . . . | 2 ounces |
| Water . . . . . . | 20 ,, |

A, B, and C are mixed, and paper is coated with it as soon as possible, just as described in the last process. The exposure is very short, being only about half or one-third that necessary with sensitised-albumenised paper.

After exposure D is applied with a brush till the image appears blue on a white or bluish ground. If the ground be darker than very *light* blue, this shows that the exposure has been too short. The print is now dipped in E, which removes the slight tint from the ground and darkens the lines. It is washed and dried.

*Pellet's Process*

A.[1]

| | | |
|---|---|---|
| Oxalic acid . . . . | 5 | grams |
| Iron perchloride . . . | 10 | ,, |
| Water . . . . . . | 100 | c. c. |

B.

| | | |
|---|---|---|
| Potassium ferrocyanide . . | $3\frac{1}{2}$ | ounces |
| Water . . . . . . | 20 | ,, |

C.

| | | |
|---|---|---|
| Hydrochloric acid . . . | 2 | ounces |
| Water . . . . . . | 1 | pint |

A is the sensitising solution, B is the developing solution, and C is the clearing bath. The exposure is about the same as that for the last described process, and the manipulations are the same also.

[1] *Photographic News*, April 5, 1878.

THE END

*Printed by* R. & R. Clark, *Edinburgh*.

ADVERTISEMENTS

# INDEX

# INTRODUCTION

## HOW TO SELECT AN APPARATUS

AMATEUR Photography has of late made such rapid progress, and found so much favour with all classes of the community as one of its most fascinating and educational pursuits, that it would be as well, perhaps, for us to give a few hints that may be of service to those desirous of taking it up. The chief cause of the great progress lay in the introduction of *dry plates*, which, being ready prepared for use, and of but small cost, save at least one half the trouble, annoyance, and mess that amateurs experienced in the old *wet plate* or "collodion" days, when the process was very properly called the "Black Art." Again, there have been a vast number of improvements in the various apparatus employed, tending in all directions to make the taking of really first-class photographs both simple, easy, and clean.

Seeing that the best of everything can now be obtained at so small a cost, we would earnestly advise beginners to avoid cheap apparatus, or rather the many so-called second-hand lots that are now offered; for unless the purchaser can be sure of his apparatus, they are dear at any price. When selecting a set, the first things demanding consideration are the quality of lens and workmanship of camera. Many of our cheaper sets are really good. We have received great numbers of flattering testimonials for our "*Oxford*" and "*Student's*" sets, but of course they possess but little of the finish and higher qualities that are provided in the "*Superior*" sets, and which greatly aid the amateur in the production of his work, and tend to the more thorough enjoyment of it. The second point for attention will be the size of photographs desired. It would be well to give this every consideration, as a large picture can be taken with almost as much ease as a small one, and again, when finished, it is so vastly superior to the latter in boldness and vigour; while the smaller picture can always be taken when required by the larger apparatus by means of what is known as an inner carrier. We must also mention that no damage is done to any apparatus when learning; it would therefore be extravagant to buy a cheap set for that purpose, and then a more expensive one immediately afterwards. No doubt compactness and lightness are very desirable qualities, but they are, we think, not of such great importance as is sometimes imagined. A small cheap camera can always be obtained when needed. One other matter, and we close this brief introduction. Be content to persevere with what you first decide to purchase; having, for instance, got one brand of plates, stick to them. Nothing whatever is gained by the beginner trying first one brand and then another, while much very useful experience is lost. Our "Practical Guide to Photography" gives every information necessary; and with but a small amount of patience and practice, the novice cannot fail to produce such work as will do him credit, and be a source of endless amusement and instruction both to himself and friends. It is specially recommended that from the very commencement a note-book, such as we supply at a shilling, and a cheap scrap album be obtained, for the purpose of noting every particular of each picture in the former, and of having a reference copy corresponding in number in the latter; the comparison of the prints with the notes will afford many opportunities for profiting by past experience.

Purchasers residing abroad would do well to note that the quantities of plates, etc., supplied with the sets are not sufficient stock for foreign orders where it may be difficult to replenish, therefore it will be wiser to order an extra supply of plates and chemicals, so as to save further expenses of freight. Each set is, however, *quite complete* with everything necessary for an immediate commencement of work. The Printing Sets are for taking the paper prints from the glass negatives (which are taken by the Photographic or Negative Set), and are sold separately, as in some instances amateurs prefer that professional photographers should do their printing. It is also more convenient for travelling, as the printing set need never be taken away from home.

Our terms are in all cases "nett cash with order," and the prices do not include packing cases, which, in the event of orders for abroad, should be tin lined. Feeling sure that nowhere can such good value be obtained at the prices, we have every confidence in introducing to your notice the following revised list. Should other descriptions of goods be required, we should be happy to obtain them to order, or to send estimates or particulars.

MARION & CO.

22 & 23 Soho Square, London, W.

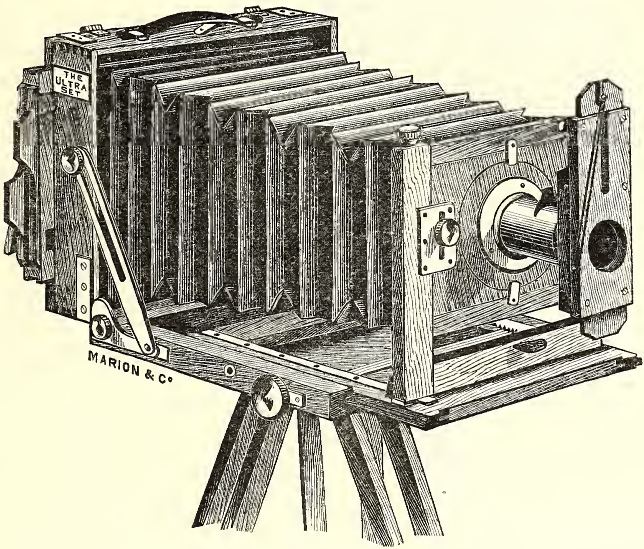
*Post Office Orders payable at Greek Street Post Office. Cheques crossed "Bank of England."*

Telegraphic Address—NOIRAM, LONDON.

MARION'S NEW SETS OF PHOTOGRAPHIC APPARATUS—
*Continued.*

# THE ULTRA SET.

For Plates $8\frac{1}{2} \times 6\frac{1}{2}$.




Camera, 3 Backs, Lens, Shutter, and Tripod, as described in Ultra Set for Plates $6\frac{1}{2} \times 4\frac{3}{4}$.

## Price complete, £11.

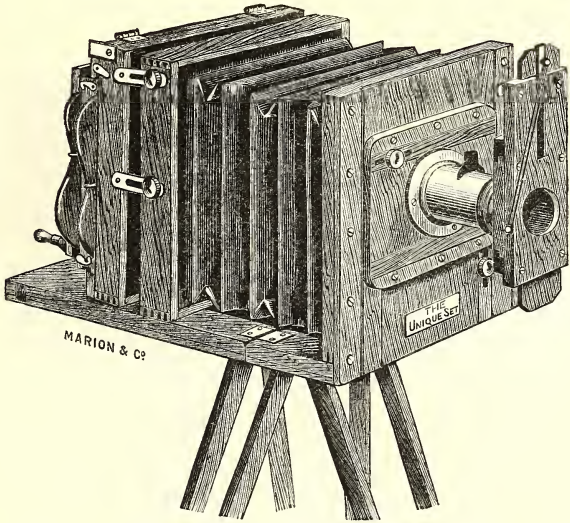
If fitted with Marion's Superior View Lens, 38s. extra.

**MARION & CO., 22 & 23 Soho Square, London, W.**

MARION'S NEW SETS OF PHOTOGRAPHIC APPARATUS—
*Continued.*

# THE UNIQUE SET.

For Plates $6\frac{1}{2} \times 4\frac{3}{4}$.




Well-made substantial Mahogany Folding Camera, with Screw Adjustment, Reversing Frame, Double Swing, Sliding Front, Double Dark Slide, good Rectilinear Lens, fitted with Instantaneous Shutter and a good strong Sliding Tripod Stand.

## Price complete, £5 : 15s.

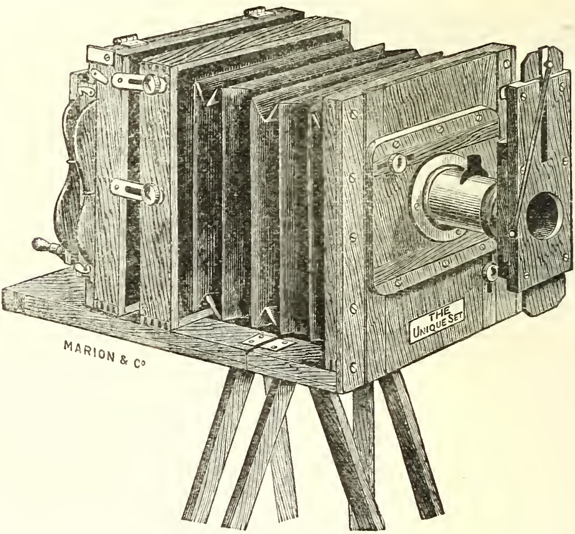
If fitted with Marion's Superior View Lens, 41s. extra.

**MARION & CO., 22 & 23 Soho Square, London, W.**

MARION'S NEW SETS OF PHOTOGRAPHIC APPARATUS—
*Continued.*

# THE UNIQUE SET.

For Plates $8\frac{1}{2} \times 6\frac{1}{2}$.




Camera, Double Back, Rectilinear Lens, Instantaneous Shutter, and good strong Tripod, as described in the Unique Set for Plates $6\frac{1}{2} \times 4\frac{3}{4}$.

## Price complete, £8 : 8s.

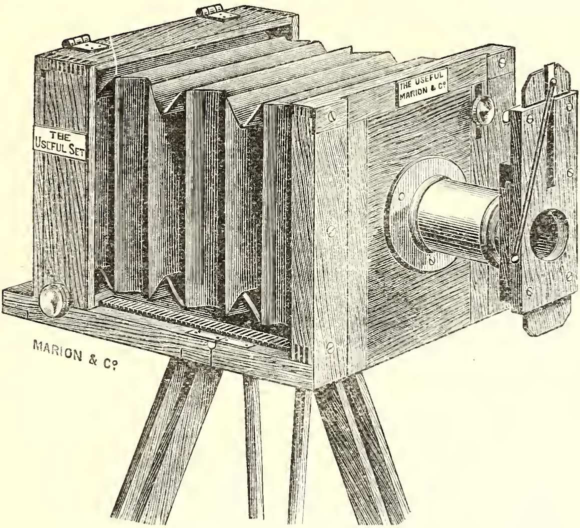
If fitted with Marion's Superior View Lens, 38s. extra.

MARION & CO., 22 & 23 Soho Square, London, W.

MARION'S NEW SETS OF PHOTOGRAPHIC APPARATUS—
*Continued.*

# THE USEFUL SET.

For Plates $6\frac{1}{2} \times 4\frac{3}{4}$.




Strong Mahogany Folding Camera, with Rack and Pinion Adjustment, good View Lens, fitted with Shutter and a good strong Sliding Tripod.

Price complete, £4 : 4s.

MARION & CO., 22 & 23 Soho Square, London, W.

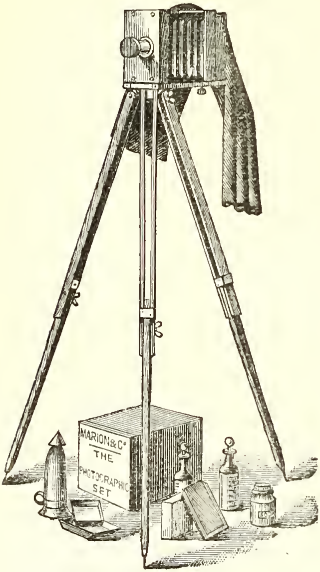
MARION'S NEW SETS OF PHOTOGRAPHIC APPARATUS—*Continued.*

# THE "U" SERIES OF PHOTO OUTFITS.

## WITH DETAILED PRICES.

| NAME. | Camera and 1 Double Back. | Extra Backs. | Lens. | Shutters. | Stand. |
|---|---|---|---|---|---|
| | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. |
| THE UNITED, for ½ plates | 5 5 0 | 0 18 0 | 1 1 6 | 0 5 6 | 0 15 0 |
| THE UNIQUE, for ½ plates | 3 18 0 | 0 16 0 | 1 1 6 | 0 5 6 | 0 10 0 |
| THE UNIQUE, for 1/1 plates | 5 16 6 | 1 0 0 | 1 15 0 | 0 6 6 | 0 10 0 |
| THE ULTRA, for ½ plates<br>With 3 Double Backs. | 6 3 0 | 0 18 0 | 1 1 6 | 0 5 6 | 0 18 0 |
| THE ULTRA, for 1/1 plates<br>With 3 Double Backs. | 7 16 6 | 1 2 0 | 1 15 0 | 0 6 6 | 1 2 0 |
| THE USEFUL, for ½ plates | 2 12 0 | 0 10 0 | 0 16 0 | 0 5 6 | 0 10 6 |
| THE UNION, for ¼ plates<br>With 6 Marion's Compacta Envelopes.<br>Extra Envelopes, 2s. each. | 3 2 0 | ... | 0 17 0 | 0 5 6 | 0 10 6 |
| THE UNION, for ½ plates<br>With 6 Marion's Compacta Envelopes.<br>Extra Envelopes, 2s. 6d. each. | 4 7 0 | ... | 1 1 6 | 0 5 6 | 0 10 6 |
| THE UNION, for 1/1 plates<br>With 6 Marion's Compacta Envelopes.<br>Extra Envelopes, 3s. 6d. each. | 6 4 6 | ... | 1 15 0 | 0 6 6 | 0 14 0 |
| THE UTILITARIAN, for ½ plates | 2 1 0 | 0 10 6 | 0 15 0 | ... | 0 14 0 |
| THE UNIVERSAL, for 5 × 4 plates | 0 16 6 | 0 7 6 | 0 15 0 | ... | 0 10 6 |
| | Camera and Stand. | | | | |
| THE UNEQUALLED, for ¼ plates | 0 16 0 | 0 5 0 | 0 5 0 | ... | ... |

# MARION'S
# NONPAREIL SET.




**THE CHEAPEST AND BEST**
**COMPLETE PHOTO-APPARATUS**
*That has ever been made.*

---

## Price 30s.

---

Size of Plate, $4\frac{1}{4} \times 3\frac{1}{4}$.

*Comprising—*

1 Mahogany Camera, with Double Back, 1 good Working Lens, a Tripod Stand, Focussing Cloth, 1 dozen Dry Plates, Dishes, Solutions, etc. etc., and

Complete and clear Instructions how to work.

---

**NONPAREIL PRINTING SET,** with Stock of Material, Dishes, Mounts, etc. etc. . 12s. 6d.

*This Set will be found just the thing for young people, and has been adopted in several Schools.*

---

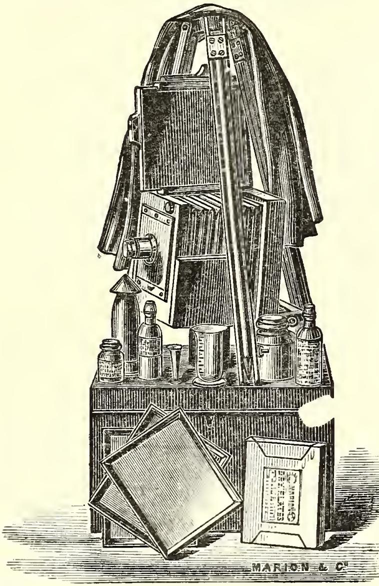
From OSSMAN SKEVKY, Imperial Naval College, Halki, Constantinople.—"The Box is very well packed in tin, as your letter indicated. I am thoroughly satisfied with the Camera, it is so well made, finished, and complete; the Printing Apparatus is the same. It far exceeds my highest anticipations."—*February* 26, 1887.

INSTRUCTIONS HOW TO WORK SUPPLIED WITH EACH SET.

---

**MARION & CO., 22 & 23 Soho Square, London, W.**

# MARION'S
# "UNIVERSITY" PHOTOGRAPHIC SET.
## FOR NEGATIVES $8\frac{1}{2} \times 6\frac{1}{2}$.




*Comprising*—Leather Bellows Body Camera, Screw Adjustments, Extending Back, Single Swing, and 3 Double Backs; Strong Tripod in Twill Case, Single View Lens, 1 dozen Britannia Plates, Bottle of Britannia Solution, Liquid Ammonia, Alum, and Hypo; Nest of 3 Ebonite Trays, Glass Measures, Ruby Candle Lamp, and Focussing Cloth.

*Contained in Black Polished Pine Case complete.*

## Price £10.

The unprecedented success which has attended the sale of our "Student" and "Oxford" Sets has induced us to comply with the repeatedly expressed desires of our friends, and to introduce the above Set for whole plates ($8\frac{1}{2} \times 6\frac{1}{2}$), which is constructed as nearly as possible after the same manner. It will be patent to all, that with each increase of size there must be a proportionate rise in cost; but the above Set has almost all the advantages of superior finished instruments, and, with careful usage, is in all respects fitted for the production of good class work.

**MARION & CO., 22 & 23 Soho Square, London, W.**

out and indoor practice. It will be noted that all essentials are included at a moderate cost consistent with quality; and the possessor need have no fear but that his instrument will favourably compare with that of any brother artist whom he may meet, both in appearance and adaptability, while in durability it is surpassed by none.

(*For Whole-Plate Sets see next page.*)

**Printing Set** for above, containing all necessary apparatus and a proportionate supply of material to the 3 dozen Plates supplied with Photo Set, **£2 : 5s.**

We can also supply a set of precisely the same quality and construction as that above described, for the following sizes at prices appended :—

| | | Printing Set. |
|---|---|---|
| For Plates $4\frac{1}{4} \times 3\frac{1}{4}$ ("Quarter-Plate," used for C.D.V. Pictures) | £10 : 10s. | £1 : 10s. |
| ,, 5 × 4 (much approved amateur size) . . | £14 : 14s. | £2 : 0s. |
| ,, $7\frac{1}{2} \times 5$ (a very elegant size for photographs) . . | £18 : 10s. | £2 : 10s. |

If desired the lens supplied with the above-mentioned "Half-Plate" Set can be replaced by a Voigtländer, Dallmeyer, or Ross, at following additional prices :—

| Voigtländer. | Dallmeyer. | Ross. |
|---|---|---|
| No. 00A. | 8 × 5 Rapid Rectilinear. | 8 × 5 Rapid Symmetrical. |
| £1 : 11s. | £2 : 9s. | £2 : 4s. |

From Captain MAXWELL, 64th Regiment, Barbadoes, W. Indies.—"I acknowledge safe arrival of Photo Apparatus, which has given complete satisfaction, and was very well packed."—*July* 12, 1885.

From J. W. BACON, Esq., Bath Cottage, Southend Road, Hampstead, N.W.—"I write to say that I am quite satisfied with the Apparatus (Superior Half-Plate), which you supplied to me. I enclose a copy of my first attempt, which was produced by carefully following the instructions laid down in your *Guide to Photography*, without any other aid whatever."—*April* 19, 1886.

**MARION & CO., 22 & 23 Soho Square, London, W.**

durability, compactness, and finish. The advantage of a "Whole-Plate" Set consists in its being capable of use for smaller pictures when the larger and more effective size is not required. These Cameras are suited alike for Portraiture and Landscape work; and when the effectiveness of the size of picture is fully estimated, it is usually thought that a Whole-Plate is, notwithstanding its being somewhat more bulky, the most desirable-sized instrument.

**Printing Sets,** suitable for above, and containing all necessary apparatus, and a proportionate supply of material to the 3 dozen Plates supplied with the Photo Sets, £3.

*Packing Charge, if sent into the Country, 6s. 6d.*

When the Lens is replaced by the following makes, an additional charge is made:—

Voigtländer.—No. 1A—£2 : 12s. No. 3—£4 : 3s.
Dallmeyer.—$8\frac{1}{2} \times 6\frac{1}{2}$, Rapid Rectilinear—£3 : 10.
Ross.—$8\frac{1}{2} \times 6\frac{1}{2}$, Rapid Symmetrical—£2 : 12s.

(*For smaller Size, "Superior" Sets, see preceding page.*)

---

# MARION'S

# SUPERIOR "TEN BY EIGHT" PHOTOGRAPHIC SET

SIZE OF NEGATIVE, 10 × 8.

We supply this in the same form and completeness as the "Whole-Plate" Set; the same description answering for both. This is a very effective photographic size, and is largely used. A good size Photograph makes a better show in a collection than the smaller sizes; and, as regards working, there is no greater difficulty in manipulation.

**Price of Photographic Set, complete, as above, £28; Printing Set, £4 : 5s.**

---

**From Lieut. J. W. MACGILLIVRAY, Fort-George, by Inverness.**—"I received the Whole-Plate Set you sent, and am well pleased with it and its belongings."—*March* 12, 1886.

**From T. RIGG, Esq., Solicitor, Wigton, Cumberland.**—"I have received the Set, and am very much pleased therewith."—*October* 6, 1885.

**From Count CHALLK, Grosspriesen, Elbe.**—"He is very glad to say that the (Superior Whole-Plate) apparatus works very well, and that he has got most gratifying results."—*October* 5, 1884.

**From the Rev. E. A. ADAMS, St. John's Road, Eastbourne.**—"I am extremely pleased with my Box and Camera and Set (10 × 8), and am glad I was persuaded to have it instead of the Whole-Plate."—*December* 4, 1884.

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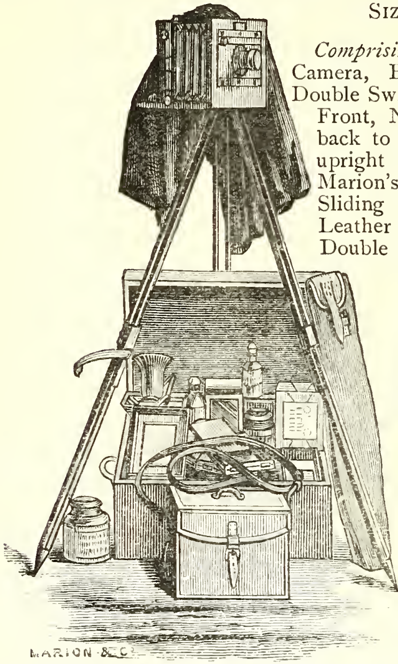
**MARION & CO., 22 & 23 Soho Square, London, W.**

# MARION'S
# SUPERIOR TWELVE BY TEN PHOTOGRAPHIC SET

SIZE OF NEGATIVE, 12 × 10.



*Comprising*—Best-make Spanish Mahogany Camera, Bellows Body, Rack Adjustment, Double Swing, Horizontal and Vertical Sliding Front, New Reversing Arrangement at the back to allow the Slides to be used either upright or oblong way, 3 Double Backs, Marion's No. 5 Rapid Rectilinear Lens, Strong Sliding Tripod, Velvet Focussing Cloth, Leather Case (to contain Camera, the 3 Double Backs, Lens, Cloth, etc.), Waterproof Case for Stand, 3 dozen 12 × 10 Britannia Plates, Bottle Britannia Solution, Liquid Ammonia, Alum, Hypo, 1 Rocking Developing Tray, 2 Compo Trays, Zinc Washing Tank, Ruby Lantern, 2 Glass Measures, Draining Rack, and 2 each Inner Carriers to take 10 × 8 and $8\frac{1}{2} \times 6\frac{1}{2}$ Plates when desired.

*All in a Black Polished Pine Case, with divisions, and lined green baize.*

## Price £34.

The above Set is of the best material, and complete in every respect for making negatives. The Camera is suitable either for Field or Studio work, and is fitted with a new arrangement for working the Backs, either horizontally or vertically, without disturbing the body of the Camera. This is a very great convenience for all kinds of Landscape work. The 12 × 10 is an effective photographic size, and is largely used; in fact, it will always be found that a good size photograph is far more effective and makes a better show in any collection than the smaller sizes, and as regards working there is no greater difficulty in using the 12 × 10 than in the smaller sizes.

**Printing Set, Apparatus, and Stock of Material suitable for the above, £5.**

*Packing Charge, if sent into the Country, 7s. 6d.*

# THE MIDDLEMISS PATENT CAMERA,

of which a description is given on page 47, can, if desired, be substituted for the Cameras as described with any of our "Superior" Sets, without any difference in cost.

**MARION & CO., 22 & 23 Soho Square, London, W.**

simple way in which the difficulty is overcome of changing successive plates will, we are sure, be much appreciated, and will be admitted as superior to any other method employed. The total weight of the half-plate Camera, with its drawer complete, is under 4 lbs.

Extra drawers are supplied, and being made to a gauge, are interchangeable in the Camera. Each drawer contains 8 Holders, and being light and compact, a large number of Plates may be carried at a minimum of weight and bulk. The Camera is adapted for use either upright or oblong way. It is easily set up. Its power of expansion or contraction allows the use of any Lens. Its front shifts in all ways. Focussing is easy, being adjusted by rack-work and fixed by a screw. The Camera is well balanced. The focussing-glass is in a supplementary groove in the body of the Camera. The sliding bottom board has a scale, so that any of the plates may be used after once focussing.

## SIZES AND PRICES.

*The Drawer with 8 Slides and the Ground Glass Screen included.*

$6\frac{1}{2} \times 4\frac{3}{4}$, £10. | $8\frac{1}{2} \times 6\frac{1}{2}$, £13 : 10s. | 10 × 8, £15 : 10s.

**Made in Best Mahogany.**

## ACCESSORIES.

| | | |
|---|---|---|
| Telescopic Camera Stand, extra strong | ... | 35/ |
| Extra Drawers, containing 8 Slides or Holders | $6\frac{1}{2} \times 4\frac{3}{4}$ | 40/ |
| Do. do. | $8\frac{1}{2} \times 6\frac{1}{2}$ | 50/ |
| Do. do. | 10 × 8 | 55/ |
| Inner Carriers | $6\frac{1}{2} \times 4\frac{3}{4}$ | 2/6 |
| Do. | $8\frac{1}{2} \times 6\frac{1}{2}$ | 3/ |
| Strong Leather Case for Camera | $6\frac{1}{2} \times 4\frac{3}{4}$ | 30/ |
| Do. do. | $8\frac{1}{2} \times 6\frac{1}{2}$ | 35/ |
| Do. do. | 10 × 8 | 40/ |
| Strong Waterproof Case for Telescope Stand | ... | 10/6 |

## THE "ENJALBERT" SET.

(*N.B.—Equal to a Camera with* 8 *Double Backs.*)

Comprising Camera, Marion & Co.'s View Lens, Stand, 1 extra Drawer, 4 Inner Carriers, Leather Cases, 1 gross Britannia Dry Plates, Chemicals, Trays, Measure, Washing Apparatus, Lamp, Strong Box with partitions.

No. 1. For Plates $6\frac{1}{2} \times 4\frac{3}{4}$, £25 | No. 2. For Plates $8\frac{1}{2} \times 6\frac{1}{2}$, £30
No. 3. For Plates 10 × 8 (with only 4 Carriers), £39.

**From FAIRFAX RHODES, Esq., Eskadel House, Beauly, N.B.**—"I am much pleased with the "Enjalbert" Set I got from you, and am astonished how soon I got into it, so as to print a good picture."—*July* 14, 1884.

**MARION & CO., 22 & 23 Soho Square, London, W.**

THE NEW ACADEMY CAMERA—*Continued.*

For another exposure repeat the operation, of course moving forward the tray by the rack-work till the brass finger points to the next notch. There is no difficulty in working—one point only requires care and judgment, viz. time of exposure. This difficulty can only be overcome by experience. The revolving ebonite disc moves at a greater speed, as the steel spring beneath the button on face of shutter is turned from left to right, and fixed in the toothed wheel. In dull weather it may be necessary even to hold it open by the hand. This is done by holding the brass head between the finger and thumb.

**The Negatives, though small, have perfect definition, give excellent sharp prints, and make good enlargements.**

## THE PRICES BELOW INCLUDE THE LENSES.

*All these, except No.* 1, *are fitted with Driffield's Patent Focussing Mirror.*

No. 1. **ACADEMY CAMERA**, for Plates 1¼ in. square, including a pair of Lenses and Tray with 12 Plates. Size of Camera, 4 × 3 in. *Not fitted with Driffield's Focussing Mirror* . . . . . . . . . each £2 10 0

(Extra Trays for ditto, 4/ each. 1¼ in. Britannia Dry Plates, 1/ per dozen.)

No. 2. **ACADEMY CAMERA**, for Plates 2 in. square, including a pair of Lenses and Tray with 12 Plates. Size of Camera, 9 × 7 × 4¾ in. . . . . . . . each 4 15 0

(Extra Trays for ditto, 5/ each. 2 in. square Britannia Dry Plates, 1/3 per dozen.)

No. 2A. Superior Workmanship.—**Academy Camera**, best mahogany, with a pair of MARION & CO.'s Rectilinear Lenses, Tray, and Porcelain Slab for Memoranda . . each 8 7 0

(Extra Trays, with Ivory Number Tablet, 6/ each.)

No. 3. **ACADEMY CAMERA**, for Plates 3¼ in. square, including a pair of Lenses and Tray with 12 Plates. Size of Camera, 10½ × 6⅜ × 10¾ in. . . . . . each 6 0 0

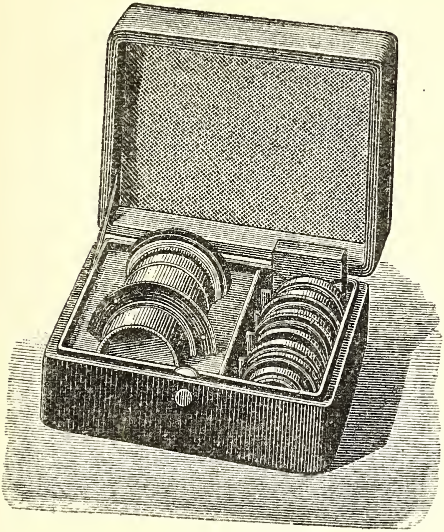
(Extra Trays for ditto, 10/ each. 3¼ in. square Britannia Plates, 1/6 per dozen.)

No. 3A. Superior Workmanship.—**Academy Camera**, best mahogany, with a pair of MARION & Co.'s Rectilinear Lenses, Tray, and Porcelain Slab for Memoranda . . each 11 10 0

(Extra Trays for ditto, with Ivory Number Tablet, 11/ each.)

**MARION & CO., 22 & 23 Soho Square, London, W.**

## MARION'S
## COMPOUND RECTILINEAR LENS.



Fitted in case with combinations for $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{1}{1}$ plates, price £5 : 5s. Thus we have one Lens serving for three sizes of plates.

*Directions for using.*—The Lens as sent out is fitted with glasses for the $\frac{1}{1}$ plate size of plate, and will be used so for that size. If required for $\frac{1}{2}$ plate, the Lenses 3B and 3H are unscrewed and replaced by those numbered $\frac{2}{2}$. When $\frac{1}{4}$ plate is the size desired, unscrew either $\frac{2}{2}$ or 3B and 3H, replacing by $\frac{1}{1}$.

## PORTRAIT LENSES.

| | | £ | s. | d. |
|---|---|---|---|---|
| 100. | Serviceable Portrait Lens for C.D.V., $1\frac{9}{16}$ diameter, 4 focus | £1 | 8 | 0 |
| 101. | ,, ,, for Cabinets, $3\frac{3}{16}$ ,, $6\frac{1}{4}$ ,, | 2 | 5 | 0 |
| 102. | Excelsior C.D.V. and Cabinet Lens, $2\frac{7}{16}$ ,, | 3 | 5 | 0 |
| 103. | For Promenade and Cabinet, will cover a whole plate, Nickel Mounts, quality guaranteed | 13 | 0 | 0 |
| 104. | Extra Rapid C.D.V. Portrait Lens, Nickel Mounts | 3 | 10 | 0 |
| 105. | Extra Rapid Cabinet ,, ,, ,, | 9 | 0 | 0 |
| 106. | Extra Rapid Promenade and Cabinet Portrait Lens | 10 | 0 | 0 |
| 107. | Portrait Lens for 10×8 Plates, diameter 4, focus 17, Nickel Mounts | 20 | 0 | 0 |

*Ross and Dallmeyer Lenses supplied at lowest list prices.*

## FOCUSSING GLASSES.

These are of the greatest possible convenience in getting perfectly sharp pictures; we recommend their constant use. 5s. and 10s. 6d. each.

From Captain A. POLLOCK, The Barracks, Belfast, Ireland.—"Your Lens is a very good one, and I got some excellent negatives with it."—*February* 14, 1885.

From JAS. HASLAM, Esq., Heywood, Ballinakill, Ireland.—"I cannot speak too highly of your goods, they are everything I could wish. The Lenses work beautifully."—*May* 8, 1886.

From W. HAWLEY, Esq., Spring Vale, near Ryde.—"The Lens you sent me on approval is an excellent one. . . . It is a great pleasure to work with such excellent material as yours, and I am extremely pleased with all."—*March* 25, 1886.

**MARION & CO., 22 & 23 Soho Square, London, W.**

# VOIGTLÄNDER'S NEW LENSES.

(*See that Voigtländer's name is on the tube.*)

MARION & CO., Sole Agents, 22 & 23 SOHO SQUARE, LONDON.

## PORTRAIT EURYSCOPES.

| | | | No. 3. | No. 4. | No. 5. | No. 6. | No. 7. |
|---|---|---|---|---|---|---|---|
| Aperture . . . | No smaller sizes will be made. | | 2 ins. | $2\frac{1}{2}$ ins. | 3 ins. | $3\frac{1}{2}$ ins. | 4 ins. |
| Equivalent Focus . | | | $7\frac{2}{3}$ ,, | $9\frac{3}{4}$ ,, | $11\frac{2}{3}$ ,, | $14\frac{1}{3}$ ,, | $17\frac{2}{3}$ ,, |
| Size of Plate . . | | | *Carte de Visite size, according to length of studio.* | | *Cabinet size, according to length of studio.* | | *Cabinet and Panel Size.* |
| Prices . . . | ... | ... | £7:14s. | £11. | £16:10s. | £22. | £28. |

**No. 3, No. 4, No. 5 have Rack Movement, all others Rigid Settings.**

## PORTRAIT EURYSCOPES (A).

**Rigid Settings.**

| | No. 1a. | No. 2a. | No. 3a. | No. 4a. | No. 5a. | No. 6a. | No. 7a. | No. 8a. |
|---|---|---|---|---|---|---|---|---|
| Aperture . . | $1\frac{1}{2}$ ins. | $1\frac{3}{4}$ ins. | 2 ins. | $2\frac{1}{2}$ ins. | 3 ins. | $3\frac{1}{2}$ ins. | 4 ins. | 5 ins. |
| Equivalent Focus | $6\frac{1}{2}$ ,, | $7\frac{1}{2}$ ,, | $8\frac{2}{3}$ ,, | $10\frac{5}{6}$ ,, | 13 ,, | $15\frac{1}{3}$ ,, | $19\frac{1}{3}$ ,, | 25 ,, |
| Size of Plate . . | Stereosc. | 4×5 ,, | 5×6 ,, | 6×8 ,, | 8×10 ,, | 10×12 ,, | 12×15 ,, | 16×20 ,, |
| Prices . . | £5:10s. | £6:8s. | £7:14s. | £11. | £16:10s. | £22. | £28:12s. | £52:5s. |

### Mr. Voigtländer's Description of the New "Portrait Euryscopes."

These new lenses, unlike the portrait lenses of usual construction, composed of one cemented front objective, and the back objective, of two separated single lenses of entirely unsimilar shape, consist of two perfectly symmetrical and cemented objectives, resembling those of the Euryscopes, and offer important advantages over the said existing constructions.

By uniting the two separated lenses of the back objective into one compound lens, a considerable amount of light formerly lost by the great number of reflecting surfaces has been saved, and by thus avoiding all "diffusion of light," the new objective gives more intensive pictures and better definition.

Besides, by the perfect symmetry of both the composing objectives a superior marginal definition and a more perfect illumination spread all over the picture have been obtained; hence, with the same focal length as formerly, a larger extension of the surface can be used, *i.e.* the angle of view and the picture itself become larger.

VOIGTLÄNDER'S LENSES—*Continued.*

They work without any distortion.

These "Portrait Euryscopes" are manufactured of two systems as regards the intensity of action, the first system having the same proportion (*i.e.* ratio of aperture to focal length) as the portrait lenses of normal rapidity, but offer the advantages of a larger picture, greater depth of focus, and a generally improved picture.

The second system, and this will be found to be most useful, has a little longer focal length, *i.e.* a little less amount of light; however, it will prove to be still sufficiently rapid for all ordinary portrait work in the studio, except for taking children, etc., where the so-called extra rapid portrait lenses are indispensable, and, as we may mention here, in the construction of which no alteration takes place. Still a larger angle of view, still a greater depth of focus, are the properties in which this system excels the first, and consequently, besides for single portraits they will be most useful for taking groups in short studios, when the use of ordinary Euryscopes, on account of their too long focal length, is precluded.

They will be excellent for instantaneous work, inasmuch as a "flare" which can occur in portrait lenses when used in the open air does not exist.

In fact, this system of the "Portrait Euryscopes," on account of their ratio of aperture to focal length, will fill a gap in the series of the existing photographic lenses, and we may state that their weight and shape are by far not so heavy and clumsy as those of the ancient long-focussed portrait lenses.

We further wish to state herewith that the present construction of all existing systems of the Euryscopes will not be subject to any alteration.

**Reprint from the "Photographischen Correspondenz," No. 310, July 1886.**

*Report of Committee of the Photographic Society of Vienna, appointed to test the new* "PORTRAIT EURYSCOPES" *introduced by* FR. VON VOIGTLÄNDER.

The undersigned have examined the new Portrait Euryscopes constructed by Chevalier von Voigtländer, of Brunswick, as to their capacity for taking portraits and groups, and have compared them with the Patzval Portrait Objectives made with separate hand lenses as hitherto used.

The trials were carried out with a new Euryscope, one of 78 mm. = 3 in., and two of 104 mm. = 4 in. diameter of lens, and compared with ordinary portrait objectives of the same dimensions (with separate hand lenses) in taking single figures and groups. The Euryscope consists of symmetrical objectives in which the front and back lenses are cemented. The diameter of lens, width of focus, and illumination of the instruments tested will be seen in the following table:—

| | Diameter of Lens. | Equivalent Focus. | Proportion of Aperture to Focus. |
|---|---|---|---|
| PORTRAIT EURYSCOPE, NO. 5A | 3 inches | 13 inches | 1 : $4\frac{1}{3}$ |
| PORTRAIT EURYSCOPE, NO. 7A | 4 inches | $19\frac{1}{8}$ inches | 1 : $4\frac{3}{4}$ |

VOIGTLÄNDER'S LENSES—*Continued.*

The angle of the perspective field in the Euryscope possesses rather above 50°, while in an old 4 in. portrait objective it does not possess more than about 40°.

The trials which have been made by the undersigned have shown that the results of the "Portrait Euryscopes," compared with those of the best portrait objectives, as made hitherto, and which we had at hand for comparison, are, as a rule, quite equal. The illuminating power of the "Portrait Euryscopes" No. 5A and No. 7A in practical photographic experiments in the studio has been found to be quite equal to that of Voigtländer's ordinary portrait objectives of normal focus (*i.e.* 105 mm. ($4\frac{1}{8}$ in.) aperture, 478 mm. ($18\frac{5}{16}$ in. focus, giving proportion of aperture to focus of 1 : 4.50), although the last named has a somewhat shorter focus than the first; the reason of this is that the light in traversing the cemented back lenses loses less light than by traversing back lenses when separated. The delineation of the image in a portrait by the Euryscope is more defined than with the ordinary portrait objective; the distribution of the lines on the surface of the image is more enlarged, the vista is more uniformly illumined, and the angle of the perspective is larger. The Euryscope gives a more exact representation of the straight lines.

The size of the image (plates) which the Euryscope gives in taking groups is shown by the following figures: The 4 in. Euryscope gives an image of 48 cm. (19 in.) diameter, whilst an ordinary 4 in. Voigtländer's objective, with separated back lenses, gives an image of only 36 cm. (14 in.) diameter.

The Euryscope answers to the requirements of all kinds of work in the photographic studio, and is specially suitable for taking groups in small studios, since it possesses a larger angle of perspective and a larger figure surface.

In conclusion we may add that the new Voigtländer "Portrait Euryscope" is the first characteristic improvement in strong portrait objectives since the introduction of the portrait construction with separate back lenses forty years ago, by reason of the above-mentioned advantages.

VICTOR ANGERER. CH. SCOLIK.
PROF. J. M. EDER. DR. JOS. SZEKELY.
J. LÖWY. VICTOR TOTH.
FRITZ LUCKHARDT. O. VOLKMER.
CARL WRABETZ.

*Vienna, May* 28, 1886.

## VOIGTLÄNDER'S NEW LENS, THE "PORTRAIT EURYSCOPE."

*From the "Photographic News" of September* 10, 1886.

From Messrs. Marion and Co., who are acting as agents to Voigtländer, we receive a new portrait lens, which has just been put upon the market to replace the original Petzval form, a form which has held almost undisputed sway during the past forty years.

The new instrument is virtually a combination of the modern symmetrical type, but having the lenses so large as to give a light intensity equal to that of the old portrait combination—that sent to us having an aperture of a trifle under 3 in. (the lenses are exactly 3 in.), with an equivalent focus of $11\frac{3}{8}$ in., thus

# VOIGTLÄNDER LENSES.

MARION & CO., Sole Agents.

The new Patent "EURYSCOPE" is unequalled. We believe these world-renowned Lenses to be the *BEST OBTAINABLE*. They possess every desirable quality, and in no single particular are they excelled by any Lenses sold.

## RAPID EURYSCOPE.

| No. | Aperture. | Equivalent Focus. | Size of Landscape. | Size of Group. | Price. |
|---|---|---|---|---|---|
| 0 | 1 inch. | $4\frac{2}{3}$ inches. | $4\frac{1}{2} \times 3\frac{1}{2}$ | $4 \times 3$ | £3 6 0 |
| 00 | $1\frac{1}{4}$ ,, | $6\frac{1}{2}$ ,, | $5\frac{1}{2} \times 4\frac{1}{2}$ | $4\frac{1}{2} \times 3\frac{1}{2}$ | 4 8 0 |
| 1 | $1\frac{1}{2}$ ,, | $8\frac{1}{6}$ ,, | $6 \times 5$ | $5\frac{1}{2} \times 4\frac{1}{2}$ | 5 10 0 |
| 2 | $1\frac{3}{4}$ ,, | $9\frac{1}{2}$ ,, | $7 \times 6$ | $6 \times 5$ | 6 7 0 |
| 3 | 2 inches. | 11 ,, | $8\frac{1}{2} \times 6\frac{1}{2}$ | $7 \times 6$ | 7 14 0 |
| 4 | $2\frac{1}{2}$ ,, | 14 ,, | $10\frac{1}{2} \times 8\frac{1}{2}$ | $8\frac{1}{2} \times 6\frac{1}{2}$ | 11 0 0 |
| 5 | 3 ,, | $16\frac{3}{4}$ ,, | $13 \times 10\frac{1}{2}$ | $10\frac{1}{2} \times 8\frac{1}{2}$ | 16 10 0 |
| 6 | $3\frac{1}{2}$ ,, | $20\frac{1}{6}$ ,, | $16 \times 13$ | $13 \times 11$ | 22 0 0 |
| 7 | 4 ,, | $23\frac{1}{4}$ ,, | $20 \times 17$ | $16 \times 13$ | 28 12 0 |
| 8 | 5 ,, | $30\frac{1}{2}$ ,, | $25 \times 22$ | $22 \times 18$ | 52 5 0 |

## MEDIUM RAPID EURYSCOPE.

Equal in rapidity to the Lenses sold by other Makers as Rapid.

| No. | Aperture. | Equivalent Focus. | Size of Plate. | Price. |
|---|---|---|---|---|
| 0a | 1 inch. | 6 inches. | $5 \times 4$ | £3 15 0 |
| 00a | $1\frac{1}{4}$ ,, | $8\frac{1}{4}$ ,, | $7\frac{1}{2} \times 5$ | 4 12 0 |
| 1a | $1\frac{1}{2}$ ,, | $10\frac{3}{4}$ ,, | $8\frac{1}{2} \times 6\frac{1}{2}$ | 6 3 0 |
| 2a | $1\frac{3}{4}$ ,, | 13 ,, | $10 \times 8$ | 7 5 0 |
| 3a | 2 inches. | 16 ,, | $12 \times 10$ | 8 16 0 |
| 4a | $2\frac{1}{2}$ ,, | 20 ,, | $15 \times 12$ | 13 4 0 |
| 5a | 3 ,, | 24 ,, | $18 \times 16$ | 19 7 0 |
| 6a | $3\frac{1}{2}$ ,, | 28 ,, | $22 \times 18$ | 25 6 0 |
| 7a | 4 ,, | 32 ,, | $25 \times 22$ | 31 18 0 |

## WIDE ANGLE EURYSCOPE.

| No. | Aperture. | Equivalent Focus. | Large Stop. | Small Stop. | Price. |
|---|---|---|---|---|---|
| 00 | $\frac{5}{12}$ inch. | $3\frac{1}{4}$ inches. | $4 \times 3$ | $5 \times 4$ | £3 13 0 |
| 0 | $\frac{6}{12}$ ,, | $4\frac{1}{6}$ ,, | $5 \times 4$ | $7\frac{1}{2} \times 5$ | 3 19 0 |
| 1 | $\frac{7}{12}$ ,, | $5\frac{1}{3}$ ,, | $6 \times 4\frac{1}{2}$ | $8 \times 6$ | 4 8 0 |
| 2 | $\frac{8}{12}$ ,, | $6\frac{1}{3}$ ,, | $7\frac{1}{2} \times 5\frac{1}{2}$ | $9 \times 7$ | 4 19 0 |
| 3 | $\frac{10}{12}$ ,, | $7\frac{1}{3}$ ,, | $8\frac{1}{2} \times 6\frac{1}{2}$ | $10 \times 8$ | 6 7 0 |
| 4 | 1 ,, | 9 ,, | $9\frac{1}{2} \times 7\frac{1}{2}$ | $12 \times 10$ | 8 7 0 |
| 5 | $1\frac{1}{4}$ ,, | 15 ,, | $13 \times 11$ | $16 \times 14$ | 11 0 0 |
| 6 | $1\frac{1}{2}$ ,, | 20 ,, | $17 \times 15$ | $20 \times 18$ | 15 8 0 |
| 7 | $1\frac{3}{4}$ ,, | 25 ,, | $21 \times 19$ | $24 \times 22$ | 20 9 0 |
| 8 | 2 inches. | 32 ,, | $23 \times 21$ | $26 \times 23$ | 33 9 0 |

From BASIL S. O. DOBREE, Tyssul Cottage, 6 Daniel Street, Newport (Mon.)—"Dear Sirs—It gives me great pleasure to be able to state that I am very pleased with the No. 1 Wide Angle Voigtländer you sent me some days since; after putting it to the most severe tests with instruments specially made for testing lenses, we came to following results, which I beg to forward on another sheet, together with test of No. 00a Voigtländer. The faults found are so infinitesimal that I doubt whether two better lenses could be readily obtained."

We shall be pleased to send any of the above Lenses on trial for a few days. The measurements given, both as regards diameter and size of plate, are rather under than above.

**MARION & CO., 22 & 23 Soho Square, London, W.**

# ROSS' LENSES.

*Ten per cent allowed off this List of Ross' Lenses.*

## PORTABLE SYMMETRICAL LENSES.

**For Landscapes, Architecture, and Copying.**

Since the introduction of photography perhaps no Lens for landscapes and architectural purposes has had so great a share of popularity as the Symmetricals. They are now universally used by many of our most eminent photographers. This is doubtless attributable to their extraordinary definition and flatness of field, as well as the exceedingly portable form in which they are constructed, all fitting the same flange.

| Nos. | Focus. | Large Stop. | Price. |
|---|---|---|---|
| 1 | 3 inches. | 3 × 3 | £3 0 0 |
| 2 | 4 ,, | 4 × 3 | 3 5 0 |
| 3 | 5 ,, | 5 × 4 | 3 10 0 |
| 4 | 6 ,, | $7\frac{1}{4} \times 4\frac{1}{2}$ | 4 0 0 |
| 5 | 7 ,, | 8 × 5 | 5 0 0 |
| 6 | 8 ,, | $8\frac{1}{2} \times 6\frac{1}{2}$ | 6 0 0 |
| 7 | 9 ,, | 9 × 7 | 7 0 0 |
| 8 | 10 ,, | 10 × 8 | 8 0 0 |
| 9 | 12 ,, | 12 × 10 | 9 0 0 |
| 10 | 15 ,, | 13 × 11 | 10 0 0 |

*Larger sizes to order.*

## RAPID SYMMETRICAL LENSES.

**For Groups, Views, Interiors, Copying, and every kind of Outdoor Photography.**

The Rapid Symmetricals, being aplanatic, work with full aperture, and are perhaps the best and most useful Lenses an Amateur or Professional Photographer can possess for general outdoor purposes. They are invaluable for all kinds of architectural subjects, dimly-lighted interiors, copying, enlarging, etc.

| View Size. | Group Size. | Focus. | Price. |
|---|---|---|---|
| 4 × 3 | Stereo. | $4\frac{1}{2}$ inches. | £4 0 0 |
| 5 × 4 | 4 × 3 | 6 ,, | 4 5 0 |
| $7\frac{1}{4} \times 4\frac{1}{2}$ | 5 × 4 | $7\frac{1}{2}$ ,, | 5 5 0 |
| 8 × 5 | $7\frac{1}{4} \times 4\frac{1}{2}$ | $8\frac{1}{2}$ ,, | 5 15 0 |
| $8\frac{1}{2} \times 6\frac{1}{2}$ | 8 × 5 | 11 ,, | 6 10 0 |
| 10 × 8 | $8\frac{1}{2} \times 6\frac{1}{2}$ | 13 ,, | 8 10 0 |
| 12 × 10 | 10 × 8 | 16 ,, | 10 10 0 |
| 15 × 12 | 13 × 11 | 20 ,, | 14 10 0 |
| 18 × 16 | 15 × 12 | 24 ,, | 18 10 0 |
| 22 × 18 | 18 × 16 | 30 ,, | 25 0 0 |

*Larger sizes to order.*

MARION & CO., 22 & 23 Soho Square, London, W.

# DALLMEYER'S LENSES.

## RAPID RECTILINEAR LENS (Patent).

**(Introduced 1866.)**

Each Lens is supplied with a Set of Waterhouse Diaphragms. (*Observe!* The apertures of stops are too large to admit of being made in the form of a *rotating* diaphragm, as supplied with the "wide-angle" Rectilinear.) Each Lens marked below, with smaller stops, can be used for the next size *larger* view.

| Size of View or Landscape. | Size of Group or Portrait. | Diameter of Lenses. | Back Focus. | Equivalent Focus. | Price, Rigid Setting. | Price, Sliding Tube. | Price, Rack and Pinion. |
|---|---|---|---|---|---|---|---|
| Inches. | Inches. | Inches. | Inches. | Inches. | £ s. d. | £ s. d. | £ s. d. |
| 4¼ × 3¼ | 3¼ × 3¼ | ⅝ | 3½ | 4 | 3 15 0 | .. | .. |
| *5 × 4 | 4¼ × 3¼ | ⅞ | 5½ | 6 | 4 10 0 | 4 15 0 | 5 5 0 |
| 6×5 for 8×5 | 5 × 4 | 1¼ | 7½ | 8¼ | 5 10 0 | 6 0 0 | 6 10 0 |
| 8½ × 6½ | 6 × 5 | 1½ | 10¼ | 11 | 7 0 0 | 7 10 0 | 8 0 0 |
| 10 × 8 | 8½ × 6½ | 1¾ | 12¼ | 13 | 9 0 0 | 9 10 0 | 10 5 0 |
| 12 × 10 | 10 × 8 | 2 | 15 | 16 | 11 0 0 | 11 10 0 | 12 5 0 |
| 13 × 11 | French Size. | 2¼ | 16 | 17½ | 12 0 0 | 12 15 0 | The 4¼ × 3¼ Lenses are constructed for lantern pictures. |
| 15 × 12 | 12 × 10 | 2½ | 18 | 19½ | 15 0 0 | 15 15 0 | |
| 18 × 16 | 15 × 12 | 3 | 22½ | 24 | 20 0 0 | 21 0 0 | |
| 22 × 20 | 18 × 16 | 3¾ | 28 | 30 | 27 0 0 | 28 0 0 | |
| 25 × 21 | 22 × 20 | 4 | 31 | 33 | 32 0 0 | 33 10 0 | |

* These Lenses are also well adapted for Stereoscopic Views, and can be had in pairs.

To obtain the best results with the sizes larger than 10 × 8, always focus with *No. 3 stop*, whether the photograph is to be taken with a smaller or a larger one.

## WIDE-ANGLE RECTILINEAR LENS (Patent).

The Lenses are mounted in *Rigid* Settings or Tubes, and each is furnished with a *Rotating* Diaphragm Plate. In the column below the largest size of plate covered by each Lens is recorded; and if *microscopic* definition up to the corners be required, the smallest, or smallest but one, stop should be used.

| No. | Largest Dimension of Plate. | Diameter of front combination. | Back Focus. | Equivalent Focus. | Price. |
|---|---|---|---|---|---|
| | Inches. | Inches. | Inches. | Inches. | £ s. d. |
| *1AA | 7¼ × 4½ | ⅞ | 3½ | 4 | 4 10 0 |
| 1A | 8½ × 6½ | 1¼ | 4⅝ | 5¼ | 5 10 0 |
| 1 | 12 × 10 | 1½ | 6¼ | 7 | 7 10 0 |
| 2 | 15 × 12 | 2 | 7½ | 8½ | 10 10 0 |
| 3 | 18 × 16 | 2½ | 11 | 13 | 14 0 0 |
| 4 | 22 × 20 | 3 | 14 | 15½ | 20 0 0 |
| 5 | 25 × 21 | 3¾ | 17 | 19 | 30 0 0 |

* This Lens is also well adapted for Stereoscopic Views.

**MARION & CO., 22 & 23 Soho Square, London, W.**

# SWIFT & SON'S LENSES.

**The Rapid Paragon for Views, Portraits, and Groups.**

Waterhouse diaphragms marked thus:—

| U.S. Nos. | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 |
|---|---|---|---|---|---|---|---|---|
| | $\frac{f}{5.657}$ | $\frac{f}{8}$ | $\frac{f}{11.314}$ | $\frac{f}{16}$ | $\frac{f}{22.627}$ | $\frac{f}{32}$ | $\frac{f}{45.255}$ | $\frac{f}{64}$ |

| Working Intensity. | Size of View. | Size of Group. | Diameter of Lenses. | Equivalent Focus. | Price in Rigid Setting. |
|---|---|---|---|---|---|
| U.S. No. 2 *F* 5·657 | 4 × 3 | Stereo. | $\frac{3}{4}$ in. | $4\frac{1}{2}$ in. | £3 12 0 |
| ,, | 5 × 4 | $4\frac{1}{4} \times 3\frac{1}{4}$ | 1 ,, | 6 ,, | 3 16 0 |
| ,, | 6 × 5 | 5 × 4 | $1\frac{1}{4}$ ,, | $7\frac{1}{2}$ ,, | 4 14 6 |
| U.S. No. 306 *F* 7 | 8 × 5 | $7\frac{1}{4} \times 4\frac{1}{2}$ | $1\frac{3}{8}$ ,, | 9 ,, | 5 3 6 |
| U.S. No. 4 *F* 8 | $8\frac{1}{2} \times 6\frac{1}{2}$ | 8 × 5 | $1\frac{1}{2}$ ,, | 11 ,, | 5 17 6 |
| ,, | 9 × 7 | $8\frac{1}{2} \times 6\frac{1}{2}$ | $1\frac{5}{8}$ ,, | 12 ,, | 6 15 0 |
| ,, | 10 × 8 | $8\frac{1}{2} \times 6\frac{1}{2}$ | $1\frac{3}{4}$ ,, | 14 ,, | 7 12 0 |
| ,, | 12 × 10 | 10 × 8 | 2 ,, | 16 ,, | 9 9 0 |
| ,, | 12 × 10 | 10 × 8 | 2 ,, | 14 ,, | 9 9 0 |
| ,, | *12 × 10 | 10 × 8 | 2 ,, | 13 ,, | 9 9 0 |
| ,, | 13 × 11 | 11 × 9 | $2\frac{1}{4}$ ,, | 18 ,, | 10 7 0 |
| ,, | 15 × 12 | 13 × 11 | $2\frac{1}{2}$ ,, | 20 ,, | 13 0 0 |
| ,, | 18 × 16 | 15 × 12 | 3 ,, | 24 ,, | 16 13 0 |
| ,, | 22 × 18 | 18 × 16 | $3\frac{1}{2}$ ,, | 30 ,, | 22 10 0 |
| ,, | 25 × 22 | 22 × 18 | 4 ,, | 34 ,, | 27 0 0 |
| ,, | 28 × 24 | 25 × 20 | $4\frac{1}{2}$ ,, | 38 ,, | 36 0 0 |

* Extensively used by Professional Photographers where position will not allow the use of 16-inch focus.

**Ten per cent is allowed off the price of the above Lenses for cash with order.**

MARION'S CAMERAS—*Continued.*

# PRICES FOR EXTRA DOUBLE BACKS.

## FOR BEST MAKE OF SPANISH MAHOGANY CAMERA.

| For Plates | $4\frac{1}{4} \times 3\frac{1}{4}$ | $5 \times 4$ | $6\frac{1}{2} \times 4\frac{3}{4}$ | $7\frac{1}{2} \times 5$ | $8\frac{1}{2} \times 6\frac{1}{2}$ | $10 \times 8$ | $12 \times 10$ |
|---|---|---|---|---|---|---|---|
| | 11/9 | 14/6 | 22/ | 25/ | 28/ | 30/ | 40/ |

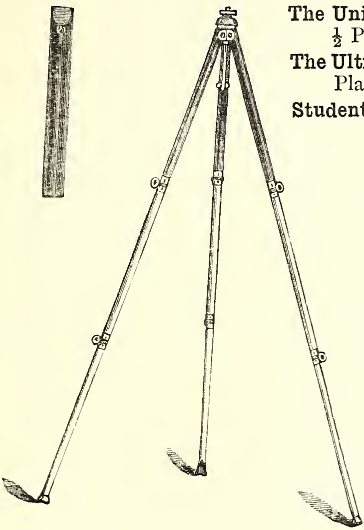
## FOR MIDDLEMISS PATENT CAMERA.

| | | | | | | |
|---|---|---|---|---|---|---|
| 11/9 | 14/6 | 22/ | 25/ | 28/ | 30/ | 40/ |

## FOR MARION'S EMPIRE CAMERA.

| | | | | | | |
|---|---|---|---|---|---|---|
| 22/6 | 24/ | 27/6 | 27/6 | 31/ | 40/ | 50/ |

# TRIPOD STANDS.



**The Union** Folding Ash Tripod Stand for $\frac{1}{2}$ Plate, 10/6, for $\frac{1}{1}$ Plate Cameras . 14/

**The Ultra** Folding Ash Tripod Stand for $\frac{1}{2}$ Plate, 18/, for $\frac{1}{1}$ Plate Cameras . 22/

**Student's** (as supplied with Set), in Oak 13/

**Oxford** (as supplied with set), in Mahogany . . . 18/

**Superior**, No. 1 (as supplied with $\frac{1}{2}$ Plate Set), in Ash . 22/

**Superior**, No. 2 (as supplied $\frac{1}{1}$ Plate Set), in Ash . . 26/

**Superior**, No. 3, Extra Strong, in Ash . . . . 30/

**3-Fold Stand**, in Polished Ash, folding to 20 inches in length, 6 inch head 21/, 8 inch 23/, 10 inch 24/.

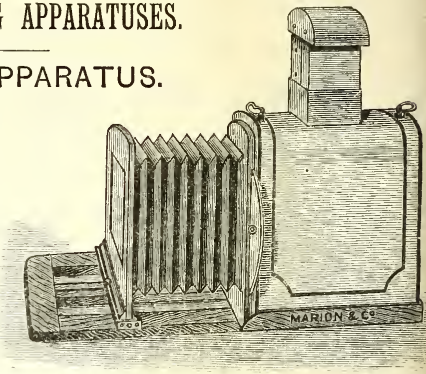
**Captain Plücker's** Patent Metal Telescopic Tripod with Ball and Socket, Jointed Head. *See Illustration*. 25/ and 35/

**Studio Camera Stands**, on Castors . . . From 50/ to £5

MARION & CO., 22 & 23 Soho Square, London, W.

# MARION'S ENLARGING APPARATUSES.

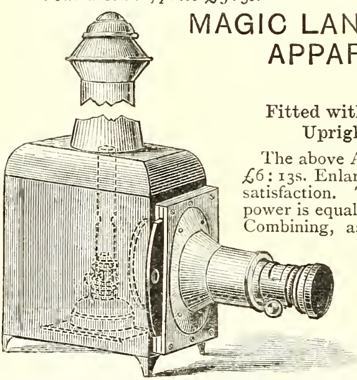
## ENLARGING APPARATUS.




Can be strongly recommended as most efficient. It also serves as an effective Magic Lantern. We supply a special Paraffin lamp which gives a bright light. The Apparatus may be used in any room, provided all actinic light be excluded; a hood, as shown in the woodcut, covers the lamp, to prevent any light escaping. Every part is movable, therefore the adjustment is easy. We append directions for use, and we may add that the operations are much simpler than they seem as described in the directions.

**Price of Apparatus complete, £6 : 13s.**

*A very good Lens for use with the above is our No.* 102, *price* £3 : 5*s.*



## MAGIC LANTERN AND ENLARGING APPARATUS COMBINED.

Price £2 : 16s.

**Fitted with Portrait Lens (No. 100), £4 : 4s.**
**Upright Easel Stand for ditto, 21s.**

The above Apparatus is made on the same principle as our £6 : 13s. Enlarging Apparatus, which has given such general satisfaction. The same lamp is used, thus the illuminating power is equal. It is fitted to take up to a ¼ plate negative. Combining, as it does, the lantern and the enlarging, this Apparatus will be found both to the Amateur and Professional one of the most useful and one of the cheapest instruments ever offered.

DIRECTIONS FOR USE.—The apparatus must be used in a darkened room from which all actinic light is excluded. It will, however, of itself give sufficient light to work by. Place it on a table or bench; a flat board should rest on an upright easel—this latter to have wheels so that it might be moved backwards or forwards. Remove the hood or metal box which covers the lamp, and light the lamp in the ordinary manner. Now take out the slide from the wood upright, and into this slide fix the negative, and then replace into its former position.

To the front of the Enlarging Apparatus must be fixed a lens (generally a ¼ or ½ plate portrait). Now adjust the bellows until an image of the size desired is thrown on the screen or board which rests on the easel (a sheet of white paper is attached to the board during this operation), and the exact focus is obtained by moving the easel stand backwards or forwards. To get the fullest power of illumination, the glass condensers as well as the lamp are made movable. There is one particular point which will be found to give the greatest light—this can only be discovered by adjustment. Now, the correct size of image, the sharpest focus, and the greatest illumination being obtained, replace the hood in its position; this will shut out all light except that which comes from the lens. The white sheet of paper is removed from the board, and sensitive paper placed there instead. Care must be taken not to disturb the position of the easel, otherwise the focus will be lost. The exposure takes place, and will depend on the nature and sensitiveness of the paper used.

A few words with respect to the lamp. Great care must be taken that the wick is always kept clean; after using, the wick should be thoroughly trimmed.

---

From FREDERICK PURDY, Esq., 35 Victoria Road, Kensington, W.—"Did you have a note from my late son, William F. Purdy, as to the good results of the Enlarging Apparatus he bought of you? I know that being much pleased with it he intended to certify to its worth."—*July* 28, 1884.

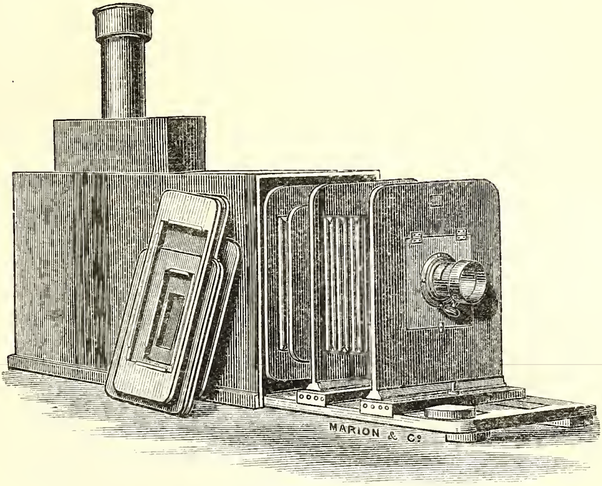
From Captain the Honourable F. W. CHARTERIS, 30 Pont Street.—"I send a cheque for your account. I am much pleased with the Enlarging Apparatus."—*January* 20, 1885.

*Particulars of Special Papers for use with Enlarging Apparatus will be found on* *page* 66.

MARION'S ENLARGING APPARATUSES—*Continued.*

# EXTRA LARGE ENLARGING APPARATUS.

**With a pair of 12-inch Condensing Lenses, and fitted with Carriers for Negatives from ¼ plate up to 12 × 10. Price £25.**




This Apparatus is fitted with Defrie's Patent Lamp for Paraffin, which gives a very effective bright and white light. Will enlarge up to 6 feet.

**May be had fitted with Portrait Lens, £3 : 5s. extra.**

Directions for use as on page 44—but this large size is fitted with a door at back to allow the working, instead of removing the hood as in the smaller sizes.

---

We strongly recommend our **Bromide Paper** and **Opals** for use with these Apparatuses.

Our **Rapid Paper,** also, is being used very effectively by many Photographers for Enlargements.

---

**MARION & CO., 22 & 23 Soho Square, London, W.**

# MIDDLEMISS PATENT CAMERA.

AN instrument that has been carefully planned to embrace all the possible improvements and advantages that can be desired in a Camera.

**STRENGTH, yet lightness.**

**RIGIDITY, yet easily opened out or shut up.**

**COMPACTNESS, yet of greater extension than usual.**

**ALL THE SWING MOVEMENTS, yet no complicated mechanism.**

**GREAT LENGTH OF FOCUS, yet can be reduced for the shortest focus of lenses.**

**Fig. I.** represents the Camera at its greatest extension and placed upon the tripod; a glance will show that the arrangement of struts is such as to secure the rigidity of the front that carries the lens, and the back that has to support the dark slide. The struts are held by movable set screws, and are so arranged that the Camera folds into very little compass.

**Fig. II.** shows the Camera closed, but placed on the tripod ready for opening. The Camera is complete in itself, and there are no loose parts.

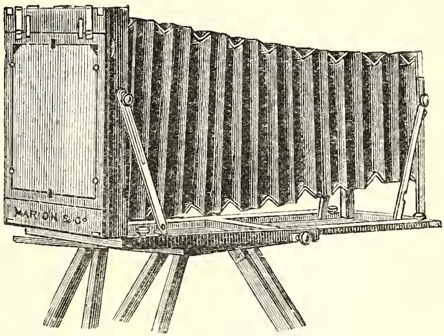



Fig. I.

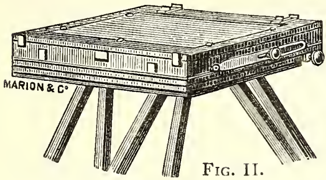



Fig. II.

**RISING AND FALLING FRONT.**—Both these movements are provided for, and can be worked easily and quickly. The exact centre is also obtainable in a moment by a reference to marks which are placed on the front of Camera.

**SHORT AND LONG FOCUS.**—While Fig. I. shows that the Camera is capable of use with a single lens (long focus), Fig. III. shows that the back of Camera can be advanced so as to allow the use of a wide-angle lens without any of the foreground being cut off, owing to the projection of the base board.

**DOUBLE SWING BACK.**—Both swings are provided in a simple manner, and can be used separately and independently.

**REVERSING FRAME.**—No Camera can be said to be complete without this useful movement. This simply consists of the frame into which the dark slide is inserted, being made to turn on its side, so that the slide may be put in horizontally or vertically without moving the Camera, but by the simple movement of reversing the frame referred to. This most desirable arrangement, if once used, will always be used.

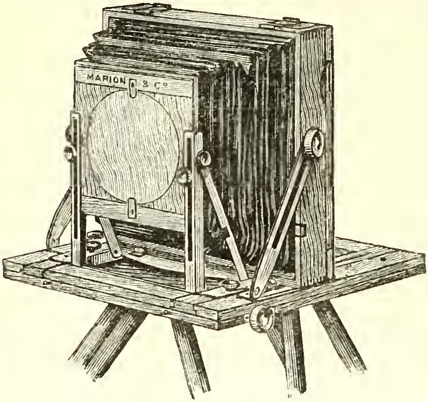



FIG. III.

**CHANGING LENSES.**—Fig. IV. shows the manner by which various lenses can be used with the Camera, and also the rigid manner in which the front is held.

**DARK SLIDES.**—Each Camera is fitted with three double slides in book form, whose shutters have double joints, and are also fitted with automatic springs to fasten them when they are pushed back after exposure. The focussing screen has double-jointed hinges. Every part of the Camera is of the best workmanship, and its principal features are fully protected by sealed patent. PRICES AS BELOW.

| | | | | | |
|---|---|---|---|---|---|
| For plates | . | $6\frac{1}{2} \times 4\frac{3}{4}$, | £8 | 0 | 0 |
| ,, ,, | . | $8\frac{1}{2} \times 6\frac{1}{2}$, | 9 | 10 | 0 |
| ,, ,, | . | $10 \times 8$, | 11 | 0 | 0 |
| ,, ,, | . | $12 \times 10$, | 14 | 10 | 0 |
| ,, ,, | . | $15 \times 12$, | 16 | 10 | 0 |

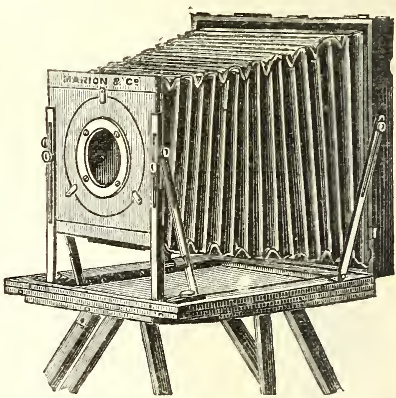



FIG. IV.

From W. ST. J. BEALE, Esq., Church Aston, Newport, Salop.—"I like the (Middlemiss Patent) Camera you sent me immensely."—*March* 11, 1886.

Mr. J. ANDERSON, Chartered Bank of India, Calcutta.—"Your Middlemiss Patent Camera is much admired, and I have seen nothing to equal it, and it stands our heat and changes of weather perfectly."

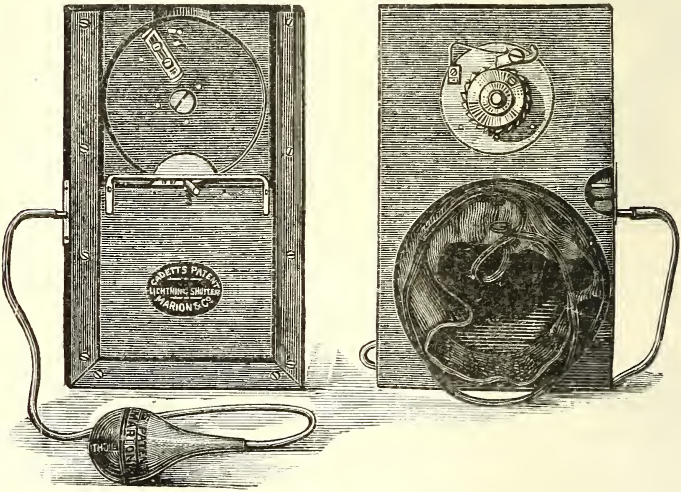
From W. ST. J. BEALE, Esq., Church Aston, Newport.—"I like my Middlemiss Camera more and more every day, and the Voigtländer Lens cannot be surpassed."—*August* 12, 1886.

**MARION & CO., 22 & 23 Soho Square, London, W.**

SHUTTERS—*Continued.*

# CADETT'S LIGHTNING EBONITE SHUTTER,

*With Cadett's Patent Pneumatic Arrangement.*



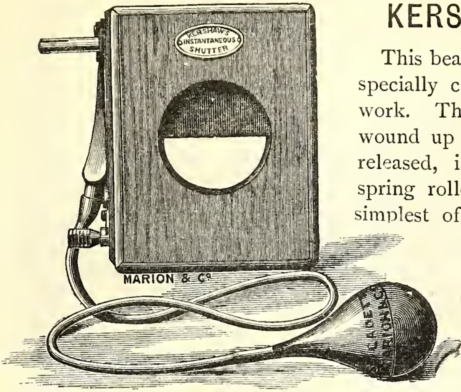

This latest invention of Mr. Cadett is a most ingenious arrangement, providing all exposures from indefinite duration to a very rapid one. The Shutter obtained the Silver Medal (highest award) at the International Inventions Exhibition. We recommend this as the "Multum in Parvo" of shutters, and also as a beautiful and ingenious piece of work. The exposures are quite under control, and are given without vibration. There is also an arrangement for focussing.

| | | | | |
|---|---|---|---|---|
| No. 1. | Suitable for lens of | $1\frac{7}{8}$ | diameter | 30/ |
| No. 2. | ,, ,, | $2\frac{3}{8}$ | ,, | 35/ |
| No. 3. | ,, ,, | $3\frac{1}{4}$ | ,, | 40/ |
| No. 4. | ,, ,, | $3\frac{1}{2}$ | ,, | 45/ |

From G. M. BAINES, Esq., Quinta Nova, Carcavellas, Correis d'Ouras, Portugal.—"I have received the Cadett's Lightning Shutter in good order, and find it an excellent piece of apparatus, combining all the requisites of an instantaneous and ordinary exposure—a great desideratum."

**MARION & CO., 22 & 23 Soho Square, London, W.**

SHUTTERS—*Continued.*




## KERSHAW'S PATENT.

This beautiful and compact Shutter is specially constructed for instantaneous work. The blind, with the hole in, is wound up before exposure, and, when released, is rapidly re-wound upon a spring roller. It is the smallest and simplest of any shutter yet introduced that will give exposures of the utmost rapidity; and we are sure it will meet with the approval of all desiring to take instantaneous photographs.

| | | | | | |
|---|---|---|---|---|---|
| No. 1. | Suitable for lens of | 2 in. | diameter, | and under, | 18/ each. |
| No. 2. | ,, | $2\frac{1}{2}$ in. | ,, | ,, | 21/ ,, |
| No. 3. | ,, | 3 in. | ,, | ,, | 24/ ,, |
| No. 4. | ,, | $3\frac{1}{2}$ in. | ,, | ,, | 30/ ,, |

## CADETT'S PATENT PNEUMATIC DROP SHUTTER FOR THE STUDIO.

*Similar in make, and on the same principle, as the "Ebonite Drop Shutter," but made in wood, and of a size to fit the largest portrait lenses.*

**Price 24s.**

All our Pneumatic Shutters can be fitted with special long tubes, so that the exposure can be effected at a distance, and the operator can thus with the greatest ease photograph himself in groups, etc., by some such means as treading on the pear at the moment of exposure.

## CADETT'S PATENT PNEUMATIC STUDIO SHUTTER.

*Made to fit inside or outside the Camera.*

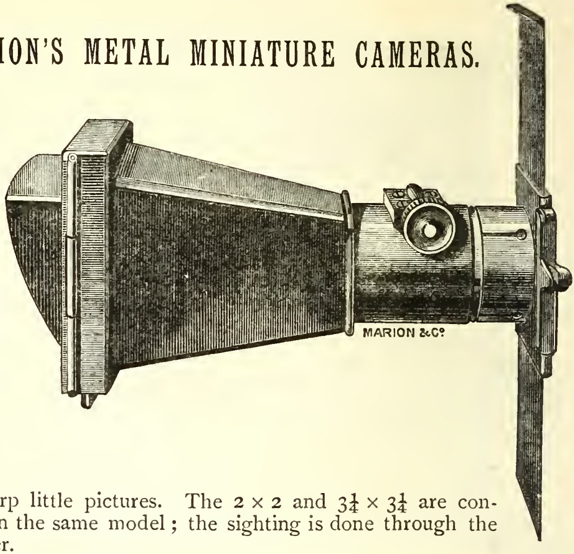
**Price 42s. each.**

It has often been remarked by eminent Photographers that any arrangement which would enable persons to be photographed without their being aware of it would be a most useful one. All that has been done in this direction necessitated the operator being by the Camera; here we have an instrument which permits him to be at any part of the studio that he pleases.

When using with very rapid Plates, we recommend the operator to put a collar of velvet round the hood of the Lens; thus the velvet flap lies against it, and is perfectly light-tight.

**MARION & CO., 22 & 23 Soho Square, London, W.**

# MARION'S METAL MINIATURE CAMERAS.




This illustration represents the Metal Miniature Camera in half size; it will be seen that the Camera and 12 slides may easily be carried in the pocket. These Cameras meet a long felt want. They have an instantaneous shutter, and, being fitted with good lenses, give most effective and sharp little pictures. The 2 × 2 and $3\frac{1}{4} \times 3\frac{1}{4}$ are constructed nearly on the same model; the sighting is done through the hole in the shutter.

Focussing is easily effected.

## FOR PLATES $1\frac{1}{4} \times 1\frac{1}{4}$.

| | £ | s. | d. |
|---|---|---|---|
| Camera, Lens, and Shutter, with one back | 1 | 5 | 0 |
| Camera, Lens, in brass, with revolving shutter, instead of the drop, as shown in illustration | 1 | 15 | 0 |
| Single Backs for same . . . each | 0 | 1 | 0 |
| Extra Rapid Plates . . . per dozen | 0 | 1 | 3 |
| Walnut Case, with Partitions, very neat | 0 | 7 | 6 |
| Complete Set, viz.: Camera and 12 Slides, in Polished Walnut Case, 6 dozen Plates, Trays, Chemicals, etc., necessary for development, and a supply of Printing Material and Apparatus. The whole complete in Polished Mahogany Box | 4 | 0 | 0 |

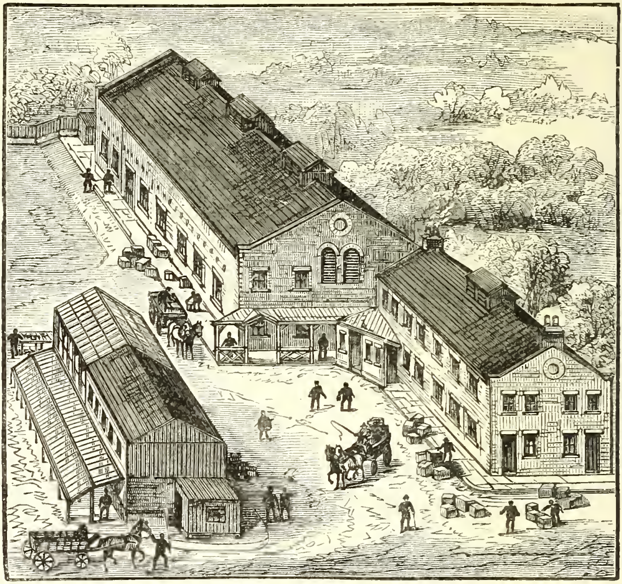
## FOR PLATES 2 × 2.

| | £ | s. | d. |
|---|---|---|---|
| Camera, Lens, and Shutter, with one back | 2 | 5 | 0 |
| Single Backs for same . . . each | 0 | 2 | 0 |
| Extra Rapid Plates . . . per dozen | 0 | 1 | 3 |
| Walnut Case, with Partitions, very neat | 0 | 10 | 6 |
| Complete Set, viz.: Camera and 12 Slides, in Polished Walnut Case, 6 dozen Plates, Trays, Chemicals, etc., necessary for development, and a supply of Printing Material and Apparatus. The above complete in Polished Mahogany Box | 5 | 10 | 0 |

## FOR PLATES $3\frac{1}{4} \times 3\frac{1}{4}$.

| | £ | s. | d. |
|---|---|---|---|
| Camera, Lens, and Shutter, with one back | 4 | 4 | 0 |
| Backs for $3\frac{1}{4} \times 3\frac{1}{4}$ Camera . . . each | 0 | 3 | 4 |
| Extra Rapid Plates . . . per dozen | 0 | 1 | 3 |
| Walnut Case, with Partitions for 12 Slides | 0 | 18 | 0 |
| Complete Set, including $3\frac{1}{4}$ in. Camera, Lens, 12 Metal Slides, Polished Walnut Case, 6 dozen Plates, Trays, Chemicals, etc., necessary for development, and a supply of Printing Material and Apparatus. The above complete in Polished Mahogany Box | 10 | 10 | 0 |

**MARION & CO., 22 & 23 Soho Square, London, W.**



MARION & CO.'S

# BRITANNIA DRY PLATES.

Manufactured at their Works, Southgate, Middlesex.

*From their cheapness and excellence are in universal use.*

## IMPORTANT NOTICE.

BRITANNIA DRY PLATES MARION

A trial of the present manufacture of these well-known plates is respectfully solicited. We give the utmost attention to the preparation, and must caution purchasers against the use of any not bearing the above name, "MARION'S BRITANNIA DRY PLATES," and Trade Mark, also label with woodcut of Southgate Works.

BRITANNIA DRY PLATES MARION

## ORDINARY RAPIDITY.

| Sizes. | Per Doz. | Sizes. | Per Doz. | Sizes. | Per Doz. |
|---|---|---|---|---|---|
| $1\frac{1}{4} \times 1\frac{1}{4}$ | 1/ | $6\frac{3}{4} \times 3\frac{1}{4}$ | 2/2 | $9 \times 7$ | 5/ |
| $2 \times 2$ | 1/3 | $6\frac{1}{2} \times 4\frac{1}{4}$ | 2/2 | $10 \times 8$ | 7/3 |
| $3\frac{1}{4} \times 3\frac{1}{4}$ | 1/6 | $6\frac{1}{2} \times 4\frac{3}{4}$ | 2/3 | $12 \times 10$ | 10/ |
| $3\frac{1}{4} \times 2\frac{3}{8}$ | 1/6 | $7\frac{1}{4} \times 4\frac{1}{2}$ | 2/10 | $15 \times 12$ | 18/ |
| $4\frac{1}{4} \times 3\frac{1}{4}$ | 1/ | $7\frac{1}{2} \times 5$ | 3/5 | *Special Sizes can be made to order.* | |
| $5 \times 4$ | 1/7 | $8\frac{1}{2} \times 6\frac{1}{2}$ | 4/3 | | |

MARION & CO., 22 & 23 Soho Square, London, W.

COWAN'S GELATINO CHLORIDE PLATES. MARION & Co.

# COWAN'S GELATINO-CHLORIDE PLATES.

COWAN'S GELATINO CHLORIDE PLATES. MARION & Co.

**Manufactured at Southgate by MARION & CO.,**
**22 & 23 Soho Square, London, W.**

| | Per Doz. | | Per Doz. | | Per Doz. |
|---|---|---|---|---|---|
| $3\frac{1}{4} \times 3\frac{1}{4}$ | 2/ | $7\frac{1}{2} \times 5$ | 7/6 | $10 \times 8$ | 14/6 |
| $4\frac{1}{4} \times 3\frac{1}{4}$ | 2/6 | $8\frac{1}{2} \times 4\frac{1}{4}$ | 8/ | $12 \times 10$ | 22/ |
| $5 \times 4$ | 4/ | $8\frac{1}{2} \times 6\frac{1}{2}$ | 10/ | $15 \times 12$ | 33/ |
| $6\frac{1}{2} \times 4\frac{3}{4}$ | 5/6 | $9 \times 7$ | 12/ | | |

THESE Plates in appearance differ entirely from the usual Bromide films, being very transparent and of a deep orange colour by transmitted light, but are capable of development to any density required.

Though extremely sensitive to daylight, they are much less so to gaslight; so that more artificial light may be used during development than with Bromide Plates. This will be found to be of great advantage, as the Plates may be examined from time to time within a reasonable distance of a gas-flame, and the density thus regulated to a great nicety.

The exposure to diffused daylight will vary from 1 to 5 seconds, according to the density of the Negative. For the reasons mentioned above, it is not recommended to make the exposures to gaslight, but a very reliable method, when a number of pictures are required exactly alike—or when it is necessary to work at night—is to burn 1 inch of magnesium ribbon at from 9 to 14 inches from the Negative, according to its density.

## DEVELOPERS.

### No. 1 for Cold Tones.

| | |
|---|---|
| Potass Citrate | 136 grs. |
| ,, Oxalate | 44 ,, |
| Hot Distilled Water | 1 oz. |

### No. 2 for Warm Tones.

| | |
|---|---|
| Citric Acid | 120 grs |
| Ammon. Carb. | 88 ,, |
| Cold Distilled Water | 1 oz. |

### No. 3 for Extra Warm Tones.

| | |
|---|---|
| Citric Acid | 180 grs. |
| Ammon. Carb. | 60 ,, |
| Cold Distilled Water | 1 oz. |

COWAN'S CHLORO BROMIDE PLATES. MARION & Co.

# COWAN'S GELATINO

COWAN'S CHLORO BROMIDE PLATES. MARION & Co.

# CHLORO-BROMIDE PLATES.

**MARION & CO., Sole Proprietors, and manufactured at their Works, Southgate.**

---

*Specially prepared for making transparencies, in the Camera, or by contact printing with gas or other artificial light, also eminently suitable for reproduction of negatives and general copying purposes.*

---

| | | | |
|---|---|---|---|
| $3\frac{1}{4} \times 3\frac{1}{4}$ | 2/ | $8\frac{1}{2} \times 6\frac{1}{2}$ | 10/ |
| $4\frac{1}{4} \times 3\frac{1}{4}$ | 2/6 | $9 \times 7$ | 12/ |
| $5 \times 4$ | 4/ | $10 \times 8$ | 14/6 |
| $6\frac{1}{2} \times 4\frac{3}{4}$ | 5/6 | $12 \times 10$ | 22/ |
| $7\frac{1}{2} \times 5$ | 7/6 | $13 \times 8$ | 22/ |
| $8\frac{1}{2} \times 4\frac{1}{4}$ | 8/ | | |

*Any other Sizes to order charged in same proportion.*

THESE Plates are much slower than the ordinary Bromide used for Portrait and Landscape work, but much quicker than the pure Chloride Plates; in the Camera they will be found to give, with full exposure, very brilliant images with clear glass in the unexposed parts, making them specially valuable for general copying purposes.

The exposure for contact printing by gaslight (using an ordinary fishtail burner at 12 inches distant) varies from 10 to 15 seconds upwards, according to the density of the negative; and with the Camera, using Lens with diaphragm about $\frac{F}{24}$, and reflected sky as a source of light, 1 to 2 minutes will be required.

Any Developers may be employed that work well with Bromide Plates, but the following are recommended:—The proportions are given for 1 ounce of developer only, so that by easy calculation each one may mix the quantity best suiting his requirements.

---

**MARION & CO., 22 & 23 Soho Square, London, W.**

# COWAN'S PORTRAIT CHLORIDE PLATES.

### FOR CONTACT PRINTING.

We call attention to the beautiful results obtainable from these Plates. Charming Opal Pictures can be got with as little trouble as with Albumenised Paper, *no development being required,* but simply toning and fixing. With a good negative, an Opal Picture can be made ready for framing with delicate half tones, and the tones can be varied according to taste. No finish required. These plates being very similar in character to Albumenised Paper, require but little special description ; but as they are not as flexible as paper, some special means of printing are required, and these have been provided by Mr. Cowan's Opal Printing Frame, of which particulars will be found on a later page.

Full Instructions supplied with each box of Plates.

Prices of the prepared Opal Plates on Flashed Opal Glass, with polished surface—

| Sizes | $4\frac{1}{4} \times 3\frac{1}{4}$ | $6\frac{1}{2} \times 4\frac{3}{4}$ | $8\frac{1}{2} \times 6\frac{1}{2}$ | $10 \times 8$. |
|---|---|---|---|---|
| Price per doz. | 8/ | 16/ | 24/6 | 36/ |

**We specially recommend a trial of these Plates.**

# MARION'S READY SENSITISED PAPER,

White, Rose, or Mauve, will be found a great boon to all Photographers. It saves an immensity of trouble, is always ready for use, and with ordinary care it will keep without losing quality for months. The extra thick is a splendid paper.

| | Price per quire. | Per ½ quire. | Per ¼ quire. |
|---|---|---|---|
| Thick, either colour | 12/6 | 6/6 | 3/6 |
| Best Superfine, either colour | 14/ | 7/6 | 4/ |
| ,, ,, white, extra thick | 18/ | 9/6 | 5/ |

**Free per post, on Roller.**

# MARION'S READY SENSITISED PAPERS.

**Cut in C.D.V. and Cabinet Sizes and put up in boxes.**

| Size. | |
|---|---|
| C.D.V., No. 1, | $3\frac{1}{2} \times 2\frac{1}{4}$ in. |
| C.D.V., No. 2, | $3\frac{5}{8} \times 2\frac{1}{4}$ in. |
| CABINET | $5\frac{5}{8} \times 4$ in. |

| Quire. | | Sheets. | Per Box. Thick Rives. | Per Box. Best Superfine. |
|---|---|---|---|---|
| 1 | C.D.V., | 1008 | 13/6 | 15/ |
| ½ | ,, | 504 | 7/3 | 8/ |
| ¼ | ,, | 252 | 3/10 | 4/3 |
| Packet | ,, | 42 Pieces | 1/ | |
| 1 | CABINET, | 366 | 13/6 | 15/ |
| ½ | ,, | 180 | 7/3 | 8/ |
| ¼ | ,, | 90 | 3/10 | 4/3 |
| Packet | ,, | 15 Pieces | 1/ | |

If sent per post, 3d. extra per box is charged.

**MARION & CO., 22 & 23 Soho Square, London, W.**

# GENERAL DRY PLATE LIST.

**BRANDS.** PRICES PER DOZEN.

| Sizes | $3\frac{1}{4}\times3\frac{1}{4}$ s. d. | $4\frac{1}{4}\times3\frac{1}{4}$ s. d. | $5\times4$ s. d. | $6\frac{1}{2}\times4\frac{3}{4}$ s. d. | $7\frac{1}{4}\times4\frac{1}{2}$ s. d. | $7\frac{1}{2}\times5$ s. d. | $8\frac{1}{2}\times6\frac{1}{2}$ s. d. | $9\times7$ s. d. | $10\times8$ s. d. | $12\times10$ s. d. |
|---|---|---|---|---|---|---|---|---|---|---|
| Academy | .. | 3 0 | 4 3 | 6 6 | 8 0 | 8 6 | 12 0 | .. | 18 0 | 26 6 |
| Argentic Bromide Opals, see page 67 | .. | .. | .. | 7 6 | .. | .. | 14 0 | .. | 20 0 | 27 0 |
| Britannia, Ordinary, see page 54 | 1 0 | 1 0 | 1 7 | 2 3 | 2 10 | 3 5 | 4 3 | 5 0 | 7 3 | 10 0 |
| Britannia, Extra Rapid, see page 55 | 1 3 | 1 3 | 2 0 | 3 0 | 3 8 | 4 10 | 5 6 | 6 6 | 9 6 | 13 0 |
| Cadett's, in grooved boxes | .. | 2 3 | 3 0 | 4 6 | 5 3 | 5 6 | 8 0 | .. | 11 0 | 17 8 |
| Chloro-Bromide (Cowan's). **A new Plate** | 2 0 | 2 6 | 4 0 | 5 6 | .. | 7 6 | 10 0 | 12 0 | 14 6 | 22 0 |
| Eastman's Neg. Paper (in boxes of 2 dozen) | .. | 2 6 | 3 6 | 5 6 | .. | 7 0 | 10 0 | .. | 14 0 | .. |
| England's Dry Plates | .. | 2 0 | 3 0 | 5 0 | 6 0 | 7 0 | 8 6 | 10 0 | 14 0 | 20 0 |
| Gelatino-Chloride (Cowan's) | 2 0 | 2 6 | 4 0 | 5 6 | .. | 7 6 | 10 0 | 12 0 | 14 6 | 22 0 |
| Globe | .. | 1 6 | 2 3 | 3 6 | 4 3 | 5 0 | 6 0 | 7 6 | 10 6 | 15 0 |
| Isochromatic (highly recommended) | .. | 2 11 | 4 3 | 5 8 | .. | 8 3 | 10 0 | .. | 16 0 | .. |
| Mawson's | .. | 1 6 | 2 3 | 3 6 | 4 0 | 5 0 | 6 6 | 9 0 | 12 0 | 16 0 |
| Paget Prize, 30 times | .. | 2 6 | 3 6 | 5 6 | 6 6 | 7 6 | 10 0 | 11 6 | 16 6 | 22 0 |
| Paget Prize, 50 times | .. | 3 0 | 4 3 | 6 6 | 7 6 | 8 6 | 12 0 | 13 6 | 18 0 | 26 6 |
| Portrait Gelatino-Chloride (Cowan's) | .. | 8 0 | .. | 16 0 | .. | .. | 24 6 | .. | 36 0 | 50 0 |
| Soho, Medium Rapid | .. | 1 6 | 2 3 | 3 6 | 4 3 | 5 0 | 6 0 | 7 6 | 10 6 | 15 0 |
| Soho, Extra Rapid | .. | 1 10 | 2 10 | 4 6 | .. | 6 3 | 7 6 | 9 2 | 13 6 | 18 9 |
| Swan's, 10 times | .. | 2 6 | 3 6 | 5 6 | 6 6 | 7 0 | 10 6 | 12 0 | 14 0 | 19 0 |
| Swan's, 20 times | .. | 3 0 | 4 6 | 6 6 | 7 6 | 8 6 | 12 0 | 14 6 | 18 0 | 26 6 |
| The Jerome Plate (imported from France—*an excellent Plate*) | .. | 2 4 | 3 6 | 5 8 | 6 8 | 8 0 | 9 8 | 10 0 | 14 0 | 19 0 |

*The following charges, including packing, are made when Plates are sent per Parcel Post*—

$4\frac{1}{4}\times3\frac{1}{4}$—1 dozen, 4d.; 2 dozen, 6d.; 3 dozen, 9d.; 4 dozen, 1/; 5 dozen, 1/3; 6 dozen, 1/6; 7 dozen, 1/9.
$5\times4$—1 dozen, 8d.; 2 dozen, 10d.; 3 dozen, 1/2; 4 dozen, 1/6.
$6\frac{1}{2}\times4\frac{3}{4}$—1 dozen, 9d.; 2 dozen, 1/3; 3 dozen, 2/.
$7\frac{1}{4}\times4\frac{1}{2}$—1 dozen, 9d.; 2 dozen, 1/3; 3 dozen, 1/9.
$8\frac{1}{2}\times6\frac{1}{2}$—1 dozen, 1/3. $10\times8$—1 dozen, 1/6.

**MARION & CO., 22 & 23 Soho Square, London, W.**

MARION'S BROMIDE PAPER—*Continued.*

We would call attention to a new business that might be created by photographers using this paper and Urie's Patent Automatic Printing Machine. Manufacturers' patterns could be photographed and prints turned out on this paper at the rate of 400 to 500 per hour, and at a very cheap rate. Photography could here compete advantageously, in regard to excellence of results, time, and cost, with mechanical printing.

## PRICES.

| | | Single Sheet. | |
|---|---|---|---|
| A Box of 24 Sheets, | $12\frac{1}{2} \times 10\frac{1}{2}$ | /6 | 9/ |
| ,, 16 ,, | $15\frac{1}{2} \times 12\frac{1}{2}$ | /9 | 9/ |
| ,, 20 ,, | $24\frac{1}{2} \times 19$ | 1/9 | 27/ |
| A roll of 10 ft. 8 in. × $24\frac{1}{2}$ in. wide | | | 9/ |

| | |
|---|---|
| **Marion's Enlarging Apparatus**, with pair of 4-inch condensers for negatives up to ¼ plate | £2 16 0 |
| **Marion's Enlarging Apparatus**, 7-inch condensers for negatives up to ½ plate | 6 13 0 |
| **Marion's Enlarging Apparatus**, 12-inch condensers for negatives up to 12 × 10 | 25 0 0 |
| **Upright Easel Stand, on wheels** | 1 1 0 |
| **Urie's Patent Automatic Printing Machine** | 10 0 0 |

**Papier-Maché Trays (Deep)**, very suitable for the development, fixing, and washing of the Bromide paper—

| $20\frac{1}{2} \times 16$ | $23\frac{1}{4} \times 20$ | $26\frac{3}{4} \times 23$ |
|---|---|---|
| 13/6 | 18/ | 22/6 |

# MARION'S ARGENTIC BROMIDE OPALS.

So perfect are the tones, and so clean and even the emulsion, that very little artistic work is required to make a finished picture.

*Plates*—$6\frac{1}{2} \times 4\frac{3}{4}$, 7/6 per doz.; $8\frac{1}{2} \times 6\frac{1}{2}$, 14/; 10 × 8, 20/; 12 × 10, 27/.

## INSTRUCTIONS FOR WORKING.

### FORMULA FOR DEVELOPER.

| | |
|---|---|
| Potass Oxalate, Saturated Solution | 4 parts. |
| Ferrous Sulphate, ,, ,, | 1 part. |

Bromide Ammonia, 2 or 3 drops of a 10 per cent Solution to every ounce.

Exposure for Contact Printing, about 20 seconds, 3 feet from a good gas burner for medium negatives.

Lay the exposed plate, face upwards, in a flat tray, and pour the developer over it, rocking the tray backwards and forwards until the print is sufficiently developed. Then wash quickly in several changes of water, and place in the fixing baths composed as follows :—

MARION & CO., 22 & 23 Soho Square, London, W.

MARION'S ARGENTIC BROMIDE OPALS—*Continued.*

## FIXING BATHS.

### Bath No. 1.

| | |
|---|---|
| SOLUTION NO. 1. | Water, 35 ozs. |
| | Hypo-Soda, 5 ozs. |
| SOLUTION NO. 2. | Water, 7 ozs. |
| | Powdered Alum, 2 ozs. |

*The two Solutions are mixed together.*

### Bath No. 2.

| | |
|---|---|
| Water | 35 ozs. |
| Hypo-Soda | 7 ozs. |

The prints are first placed in fixing Bath No. 1 until they lose the yellow colour, and then passed into Fixing Bath No. 2, where they should remain at least ten minutes.

After fixing, the prints should be washed for five or six hours, taking care that the water is repeatedly changed; it is a good plan to give them a fresh change of water the last thing over night and allow them to remain in it till morning, when they should be rinsed through two or three changes of water and then placed in a draining rack to dry.

Should the plates be found to blister or frill, we recommend the following bath to be used after the second fixing—

| | |
|---|---|
| Chrome Alum | 3 parts. |
| Water | 100 ,, |

*We are prepared to supply all the productions of the Eastman Film Company.*

**Roll Holders for all Stock Sizes.**
**Film Carriers and other Details.**

## SAMPLE BOXES.

For the convenience of beginners, we have prepared Sample Boxes containing everything necessary for making a trial of our paper, viz.—

24 Cut sheets Negative paper
2 Film Carriers for use in any ordinary dark slide
8 oz. Concentrated Developer
8 oz. Bottle Oil Vaseline
8 in. Squeegee
1 piece of Rubber Cloth
1 Ebonite sheet for drying Negatives
Instructions

| | |
|---|---|
| $4\frac{1}{4} \times 3\frac{1}{4}$ | 12/ |
| $5 \times 4$ | 13/6 |
| $6\frac{1}{2} \times 4\frac{3}{4}$ | 15/6 |
| $7\frac{1}{2} \times 5$ | 17/ |
| $8\frac{1}{2} \times 6\frac{1}{2}$ | 21/ |
| $10 \times 8$ | 27/6 |

**MARION & CO., 22 & 23 Soho Square, London, W**

# GENERAL LIST.

| | For Plates | $3\frac{1}{4}$ sqr. s. d. | $\frac{1}{4}$ s. d. | 5×4 s. d. | $\frac{1}{2}$ s. d. | $7\frac{1}{2}$×5 s. d. | $\frac{1}{1}$ s. d. | 10×8 s. d. | 12×10 s. d. |
|---|---|---|---|---|---|---|---|---|---|
| Burnishers, Cheap | (*see illustration*) | .. | 21 0 | .. | 28 0 | .. | 34 0 | .. | 45 0 |
| Cameras, various, see page 42. | | .. | .. | .. | .. | .. | .. | .. | .. |
| Carriers, Inner (outside size of Frame) for best Cameras | | 1 6 | 1 6 | 1 6 | 1 9 | 1 9 | 2 3 | 2 6 | 3 0 |
| Cases, Waterproof Canvas, for Cameras to measure | about | .. | .. | 9 0 | 10 0 | .. | 13 0 | 14 6 | 16 6 |
| Do. do. for Tripods | about | 7 0 | 7 0 | 7 0 | 7 0 | 7 0 | 8 6 | 8 6 | 10 6 |
| Chemicals, various, see page 71. | | .. | .. | .. | .. | .. | .. | .. | .. |
| Cloud Negatives, Wax Paper, very effective | | .. | 1 3 | .. | 1 6 | .. | 2 0 | 3 0 | 4 0 |
| Cutting Shapes, Glass, polished edges | | .. | 0 9 | 0 11 | 1 1 | 1 6 | 1 10 | 2 0 | 3 0 |
| Developing trays, Papier-Maché | | .. | 1 2 | 1 5 | 1 8 | 2 0 | 2 9 | 3 0 | 4 0 |
| Do. Glass, clear | | .. | 0 11 | 1 0 | 1 8 | .. | 2 11 | 3 9 | .. |
| Do. Rocking Tray, recommended | (*see illustration*) | .. | 8 6 | .. | 11 3 | .. | 12 3 | 13 3 | 15 3 |
| Draining Racks, Folding, hold 24 plates | | .. | 2 0 | .. | 2 8 | .. | 3 4 | up to | 3 4 |
| Dry Plates, see pages 54-56. | | .. | .. | .. | .. | .. | .. | .. | .. |
| Focussing Screens, finest ground patent plate | | 0 6 | 0 6 | 0 8 | 0 10 | 1 0 | 1 6 | 2 8 | 4 4 |
| Grooved Boxes, white wood, for storing 24 Negatives | | 2 0 | 2 0 | 2 3 | 2 8 | 3 3 | 3 6 | 7 0 | 7 9 |
| Do. do. do. 50 do. | | .. | 2 4 | 2 8 | 3 4 | 3 9 | 4 3 | 8 0 | 9 0 |
| Lamps, Ruby (non-actinic), see page 81. | | .. | .. | .. | .. | .. | .. | .. | .. |
| Leather Cases, with partitions for Camera and Backs | | .. | 15 0 | .. | 22 6 | .. | 26 0 | 30 0 | .. |
| Do. best quality, solid do. | | .. | 20 0 | .. | 29 0 | .. | 32 0 | 40 0 | 50 0 |
| Lenses, various, see pages 32-41. | | .. | .. | .. | .. | .. | .. | .. | .. |
| Light-tight Boxes, japanned tin, 12 plates | (*see illustration*) | .. | 1 6 | 2 0 | 2 6 | 3 0 | 3 3 | 4 9 | 6 6 |
| Do. polished mahogany, 12 plates | | .. | 3 4 | 3 9 | 4 4 | 5 0 | 5 6 | 7 6 | 9 0 |
| Negative Washing Tanks, 24 plates, with syphon | | .. | 6 2 | 6 8 | 7 2 | 8 0 | 8 0 | 10 0 | 12 0 |
| Do. do. and drainer, 24 plates, automatic | (*see illustration*) | .. | 13 0 | 14 0 | 15 0 | 15 6 | 16 0 | 18 0 | 20 0 |
| Do. do. Edwards' Registered, 24 plates | ,, | .. | 10 6 | 11 6 | 12 4 | 13 9 | 14 0 | 16 0 | 19 6 |
| Mounts, see page 77. | | .. | .. | .. | .. | .. | .. | .. | .. |
| Printing Frames, in Oak | | .. | 0 $7\frac{1}{2}$ | 0 $8\frac{1}{2}$ | 1 0 | 1 9 | 1 9 | 2 3 | 2 9 |
| Do. in Pine | | .. | 1 1 | 1 4 | 1 10 | 2 6 | 3 4 | 4 6 | 6 2 |
| Do. in Mahogany, India-rubber Cushions | | .. | 2 4 | 2 10 | 3 6 | 4 6 | 4 0 | 5 6 | 6 8 |
| Do. Cowan's Special, for Opals | (*see illustration*) | and | smalle | r sizes | .. | .. | 4 0 | 5 6 | 7 6 |
| Printing from Amateurs' Negatives | per dozen prints | .. | 3 0 | 4 0 | 5 0 | 6 0 | 7 6 | 10 0 | 12 0 |
| Plate Holders, Adcock's Patent | | .. | 2 6 | .. | 3 0 | .. | .. | .. | .. |
| Vignetting Frames, Adcock's Patent | (*see illustration*) | .. | 3 0 | .. | 3 6 | .. | 6 0 | .. | .. |
| Do. Marion & Co.'s New | | .. | 2 6 | .. | 4 0 | .. | 5 2 | .. | .. |
| Shutters, see pages 49-51. | | .. | .. | .. | .. | .. | .. | .. | .. |

*For Illustrations referred to, see pages* 86-90.

# SUNDRIES.

Accessories of every description kept in stock.
Background, Scenic. A large selection always on hand, 8 ft. × 7 ft. 6 in. wide, 50/ each.
Background, Cloth, 8 ft. wide, various tints, very nice, 3/6 per foot; any length cut; samples per post.
Background, "Empire" cloth in several neutral tints, any length cut—at per yard according to width required; samples free.
Black Paper Masks, in boxes of 3 doz. C.D.V., or 1½ doz. Cabinets, 1/; or 6 doz. lantern, 2/.
Blotting boards, specially prepared for prints, 4/6 per quire.
Changing bag as illustration, 12/; ditto square, 12/; ditto box (Cowan's), 40/.
Dropping bottles, 1/ and 1/4.
Dusting brushes, camel's hair, 9d. to 2/6.
Finder, Newbold's, *see illustration*, 3/6 each, very useful.
Focussing cloths, twill 2/6, velvet 6/.
Forceps, Ebonite, 1/ per pair.
Funnels, glass, 4d. to 2/6 each, according to size.
Glass measures, graduated, 1 dr. 8d., 1 oz. 9d., 4 oz. 1/1, etc.
Glass (non-actinic), Marion's new double flashed, 2/6 per square foot.
Head-rests, from 30/ to £4.
India-rubber gloves, 6/6 per pair.
India-rubber finger stalls, 3/ per doz.
Non-actinic fabrics, ruby 10d., and canary 1/ per yard.
Note-books (landscape), 1/ each.
Print cutting knives, 1/ each.
Rustic accessories (special prices).
Retouching pencils (Faber's), 1/ each.
Retouching leads, 2/8 per half dozen.
Scales and weights (glass pans), weighs from ½ grain to 2 drachms, *see illustration*, 3/ and 5/ per set.
Superior steel beam scales, upright brass pillar with glass pans, and mahogany box to weigh from 1 grain to 4 oz., 30/.
Spotting brushes, sable, 1/ each.
Squeegee, 3d. per in. (6 in. smallest).
Test papers (litmus), 3d. per book, blue or red.
Vignetting chair and head-rest combined; very cheap and most useful, *see illustration*, 50/ each.
Ventilators for dark room, 15/ each; light proof.

# MARION'S BEST FRENCH MOUNTS.

(*Made at their factory*, *Courbevoie*, *near Paris*.)

| C.D.V. MOUNTS. No. | Description. | PRICE. Per 1000 | Per 100 |
|---|---|---|---|
| 810. | Second quality, ivory surface, cream | 8/ | 1/ |
| 811. | Best superfine, ivory surface, white or cream | 11/4 | 1/4 |
| 812. | Second quality, enamelled surface, cream or rose | 10/ | 1/4 |
| 813. | Best superfine, enamelled surface, white or cream | 13/4 | 1/7 |
| 814. | Best superfine, ivory surface, pale rose, with carmine margins, and round corners | 14/8 | 1/9 |
| 815. | Best superfine, enamelled surface, cream, with carmine margins, and round corners | 16/8 | 2/1 |
| 816. | Best superfine, enamelled surface, with design on back, round corners, and gilt edges | 23/4 | 2/6 |
| 817. | Real gold, bevelled edges, in rose, cream, blue, black, chocolate, and olive green | 42/ | 4/5 |

| CABINET MOUNTS. No. | Description. | PRICE. Per 1000 | Per 100 |
|---|---|---|---|
| 910. | Second quality, ivory surface, cream | 26/8 | 3/4 |
| 911. | Best superfine, ivory surface, white or cream | 38/8 | 4/6 |
| 912. | Second quality, enamelled surface, cream or rose | 32/ | 3/7 |
| 913. | Best superfine, enamelled surface, white or cream | 44/ | 5/2 |
| 914. | Best superfine, ivory surface, pale rose, with carmine margins, and round corners | 47/4 | 5/4 |
| 915. | Best superfine, enamelled surface, rose, with carmine margins, and round corners | 52/8 | 6/ |
| 916. | Best superfine, cream, ivory surface, with chocolate design on back, round corners | 45/4 | 5/4 |
| 917. | Real gold, bevelled edges, in cream, rose, blue, black, chocolate, and olive green | 77/4 | 8/4 |

For Mounting Solution see page 95.

*Estimates given for printing Amateurs' own names on any of above.*

**MARION & CO., 22 & 23 Soho Square, London, W.**

# LARGE MOUNTS.

(*Manufactured by* MARION & CO., *Courbevoie, near Paris.*)

Every care is taken in the Manufacture, and the Quality will be found unsurpassed for Pureness of Material and Fineness of Surface.

## SECOND QUALITY PLAIN CREAM TONED.

*Kept in Stock.*

| No. | Thickness. | Size—Inches. | Per doz. | Per gross. |
|---|---|---|---|---|
| 1000 | 5-Sheet | 8 × 6 | /7 | 4/8 |
| 1001 | 5 ,, | 9⅛ × 7½ | /9½ | 7/1 |
| 1002 | 8 ,, | 12⅜ × 9¼ | 1/5 | 13/9 |
| 1003 | 8 ,, | 13½ × 10½ | 1/9 | 17/8 |
| 1004 | 8 ,, | 16 × 13 | 2/8 | 28/ |
| 1005 | 8 ,, | 19 × 14 | 3/4 | 33/ |
| 1006 | 10 ,, | 22 × 17 | 4/9 | 52/ |
| 1007 | 10 ,, | 25 × 19 | 5/9 | 61/ |
| 1008 | 10 ,, | 26 × 21 | 7/1 | 80/ |

## SECOND QUALITY PLAIN CREAM TONED. WITH RED LINES.

*Kept in Stock.*

| No. | Thickness. | Size—Inches. | Size of Line. | Per doz. | Per gross. |
|---|---|---|---|---|---|
| 1009 | 5-Sheet | 8 × 6 | 5¼ × 4¼ | /10 | 7/4 |
| 1010 | 5 ,, | 9⅛ × 7½ | 6⅞ × 4¾ | 1/ | 10/ |
| 1011 | 8 ,, | 12⅜ × 9¼ | 8⅞ × 6⅞ | 1/8 | 16/8 |
| 1012 | 8 ,, | 13½ × 10½ | 8⅞ × 6⅞ | 2/ | 21/4 |
| 1013 | 8 ,, | 16 × 13 | 10⅜ × 8⅜ | 3/ | 32/ |
| 1014 | 8 ,, | 19 × 14 | 12⅜ × 10⅜ | 3/7 | 36/8 |
| 1015 | 10 ,, | 22 × 17 | 15⅜ × 12⅜ | 5/4 | 58/8 |
| 1016 | 10 ,, | 25 × 19 | | | |
| 1017 | 10 ,, | 26 × 21 | | | |

## BEST WHITE OR CREAM-TONED CARDBOARD FOR MOUNTING PHOTOGRAPHS.

*Kept in Stock.*

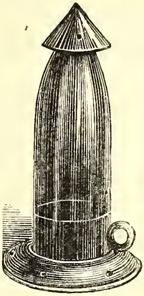
| No. | Thickness. | | Size—Inches. | Per doz. | Per gross. |
|---|---|---|---|---|---|
| 1018 | 5-Sheet | | 8 × 6 | /8 | 6/3 |
| 1019 | 5 ,, | | 9⅛ × 7½ | /11 | 8/9 |
| 1020 | 8 ,, | | 12⅜ × 9¼ | 1/7 | 17/2 |
| 1021 | 8 ,, | | 13½ × 10½ | 2/ | 21/4 |
| 1022 | 8 ,, | | 16 × 13 | 3/9 | 38/10 |
| 1023 | 8 ,, | | 19 × 14 | 4/ | 43/2 |
| 1024 | 10 ,, | | 19 × 14 | 4/8 | 50/10 |
| 1025 | 10 ,, | | 22 × 17 | 6/ | 67/4 |
| 1026 | 10 ,, | | 25 × 19 | 7/4 | 80/8 |
| 1027 | 10 ,, | | 26 × 21 | 8/11 | 100/8 |
| 1028 | 3 ,, | (for enamelling) | 24½ × 18½ | 4/ | 44/ |
| 1029 | 10 ,, | (Cream only) | 37 × 24 | 32/ | 320/ |

## INDIA TINTED BEST WHITE CARDBOARD.

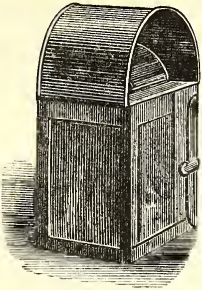
*Kept in Stock.*

| No. | Thickness. | Size—Inches. | Size of Tint. | Per doz. | Per gross. |
|---|---|---|---|---|---|
| 1030 | 5-Sheet | 8 × 6 | 5¼ × 3¾ | 1/7 | 15/4 |
| 1031 | 5 ,, | 9⅛ × 7½ | 6½ × 5¼ | 1/9 | 18/5 |
| 1032 | 8 ,, | 12⅜ × 9¼ | 8½ × 6½ | 2/8 | 27/1 |
| 1033 | 8 ,, | 13½ × 10½ | 9½ × 7½ | 3/2 | 32/4 |
| 1034 | 8 ,, | 16 × 13 | 11 × 9 | 4/8 | 50/8 |
| 1035 | 8 ,, | 19 × 14 | 12 × 10 | 4/10 | 55/ |
| 1036 | 10 ,, | 19 × 14 | 12 × 10 | 6/ | 64/8 |
| 1037 | 10 ,, | 22 × 17 | 14 × 12 | 7/4 | 80/10 |
| 1038 | 10 ,, | 25 × 19 | 16 × 14 | 9/ | 101/4 |
| 1039 | 10 ,, | 26 × 21 | 18 × 15 | 11/2 | 124/10 |

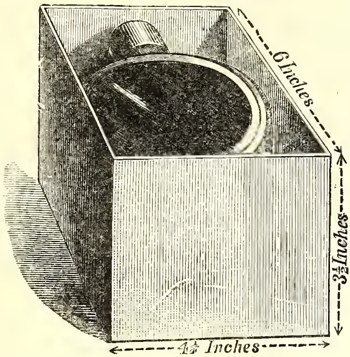
# MARION'S DARK TENT AND DEVELOPING LAMPS.



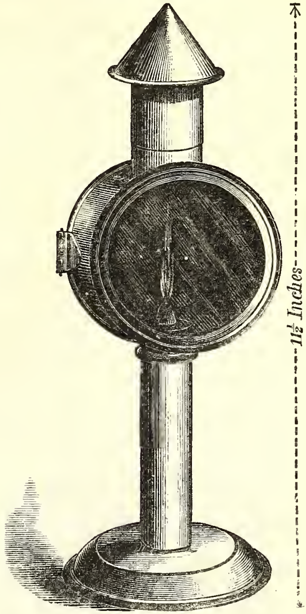
No. 1.



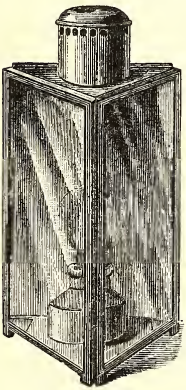
No. 2.




No. 3 in Box.

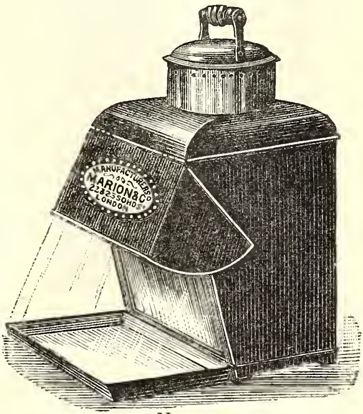



No. 3.



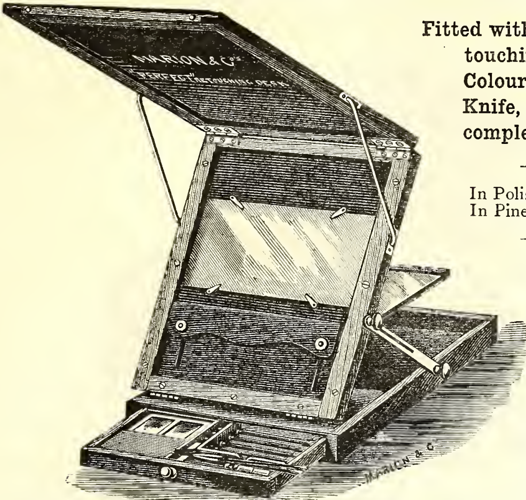
No. 4.

All our Lamps are now fitted with a new glass, flashed on one side with ruby, and the other with orange. This glass gives the greatest possible quality of light, and is yet perfectly safe for the most rapid plates. This glass can be supplied in any sizes for dark-room windows, etc.



No. 5.

# MARION'S PERFECT RETOUCHING DESK.

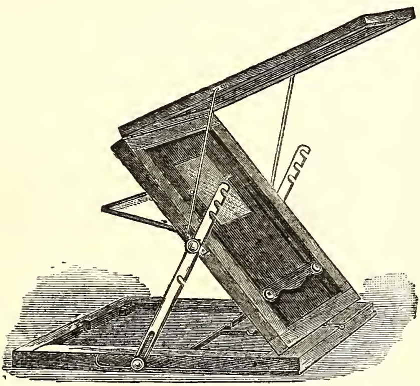


**Fitted with Faber's Pencils, Retouching Medium, Water Colours, Brushes, Palette, Knife, and Pencil Pointer, complete in Drawer.**

| | |
|---|---|
| In Polished Mahogany . | . 75/ |
| In Pine Blacked . . . | . 60/ |

This is the most complete Desk ever invented, combining all the desiderata for a Retoucher. It has, in addition to the completely fitted drawer, several special features of its own. Provision is made for retouching negatives of any size up to 12 × 10, and it so constructed that a portion only of the negative may be viewed through, so that the attention of the artist may be centred, but in the case of groups the whole width may be left open. The silvered Glass Reflector may be easily adjusted to any angle, whilst the supports of front may be readily fixed to any desired elevation.

# COLE'S RETOUCHING DESK.



**Price 50s.**

There are some new features in this Instrument which make it an improvement on other kinds in use. The platform on which the white paper or reflector is placed can be adjusted at any angle. There is a slit at the top of the instrument to allow the negative to slide through when it is desired to retouch parts of the negative, awkward to get at without this provision. The bar across front, on which the negative rests, can be shifted at different angles to facilitate working. The supports of front, as will be seen by the woodcut, can be screwed firmly at any desired elevation. The desk also forms a convenient easel, on which finishing of enlargements may be done. It can be used for negatives from $\frac{1}{4}$ plate to 10 × 12.

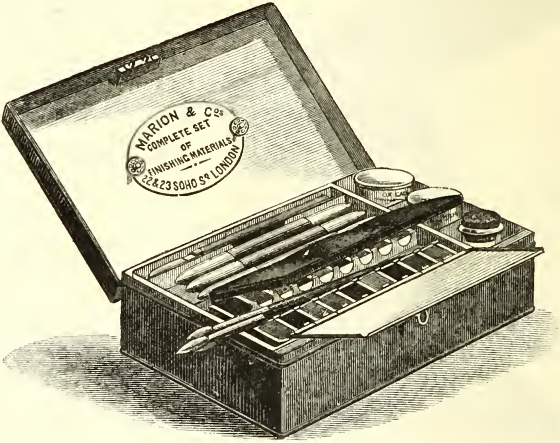
Cheap Retouching Desks, in Blackened Pine, for whole, $\frac{1}{2}$, and $\frac{1}{4}$ Plates, price 12/6.
**Cheap Retouching Desks**, strong and serviceable, for 12 × 10 Plates, with Carriers for smaller sizes, price 25/.

*Pencil Cases and leads specially prepared for retouching any grade, 1s. each.*

MARION & CO., 22 & 23 Soho Square, London, W.

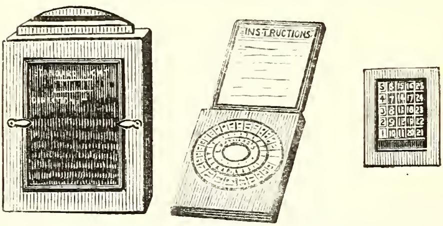
# MARION'S COMPLETE BOX OF FINISHING MATERIALS.

Price 35s.




Containing 18 half pans of Winsor and Newton's moist water colours, as follow:—Vermilion, Indian Yellow, Rose Madder, Cobalt, Aureolin, Chinese White, Vandyke Brown, Emerald Green, Sepia, Prussian Blue, Raw Sienna, Crimson Lake, Indigo, Light Red, Terre Verte, Burnt Sienna, Yellow Ochre, and Gamboge, in a Patent Spring Japanned Tin Box. Four brushes, knife, stumps, chalks, bottle of gum arabic, box of levigated pumice stone, and small pan of oxgall.

# WARNERKE'S STANDARD SENSITOMETER.




Price 15s.

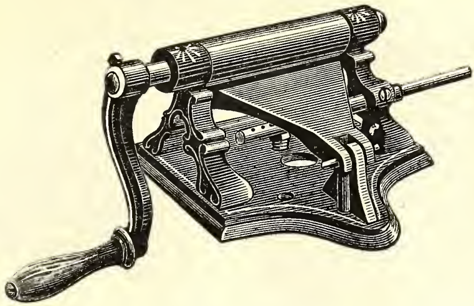
Approved by a Committee comprising several of the leading Members of the Photographic Society of Great Britain.

This Instrument has been invented by Mr. Warnerke to serve as a standard measure of sensitiveness to all the Photographers of the world. All the Standard Sensitometers register alike, and never vary. Thus, if four Dry Plates made by four different makers register (when developed alike) in four different Sensitometers the figures 16, it can be depended on, as a matter of fact, that they will all require the same exposure. In practice, the actual exposure signified by a given number soon becomes a recognised and familiar fact.

*Instructions for using will be sent with each Sensitometer.*

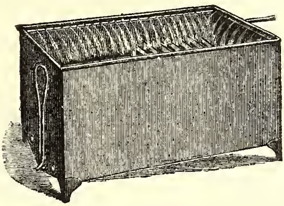
MARION & CO., 22 & 23 Soho Square, London, W.

## CHEAP BURNISHER.



Producing the brightest possible burnish; can be heated with gas or spirit. New improved pattern.

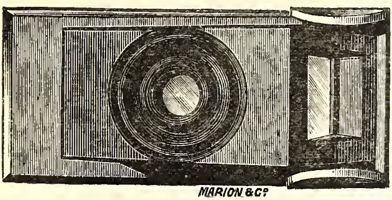
| | |
|---|---|
| For C.D.V. | 21/ |
| ,, Cabinets | 28/ |
| ,, $8\frac{1}{2} \times 6\frac{1}{2}$ | 34/ |
| ,, $12 \times 10$ | 45/ |



## JOHN EDWARD'S WASHING APPARATUS.

| | |
|---|---|
| $\frac{1}{4}$ plate | 10/6 |
| $5 \times 4$ | 11/6 |
| $\frac{1}{2}$ plate | 12/4 |
| $7\frac{1}{2} \times 5$ | 13/9 |
| $\frac{1}{1}$ plate | 14/ |
| $10 \times 8$ | 16/ |
| $12 \times 10$ | 19/6 |

This apparatus offers all the desiderata for a complete and thorough wash to the Plates. The water falls in a gentle shower; when nearly full the overflow syphon begins to work, so there will be a constant inflow and outflow. When the water is turned off the syphon sucks out the last drop, thus there is no fear of Hypo deposit remaining.

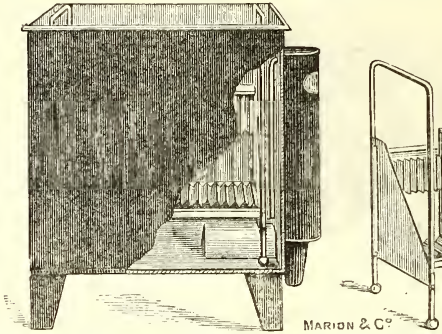



## NEWBOLD'S

## VIEW FINDER. 3s. 6d.

**MARION & CO., 22 & 23 Soho Square, London, W.**

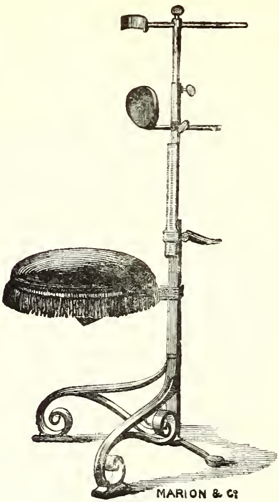
## SELF-ACTING SYPHON TANK & DRAINER, FOR WASHING NEGATIVES (Registered).




The advantage offered by this Tank is a continuous change of water without personal supervision. When the water arrives near the top, the Syphon commences to operate and swiftly empties the tank. The water from the tap, running in all the time, soon begins to refill it, and thus the operation goes on continuously, and the plates get repeated fresh baths soon after. A moderate supply of water answers the purpose well. The rack containing the plates can then be lifted bodily, and placed on the top to drain the plates.

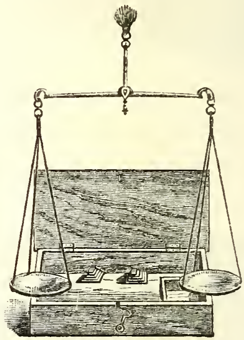
¼ plate, 13/; 5×4, 14/; ½ plate, 15/; 7½×5, 15/6; ½ plate, 16/; 10×8, 18/; 12×10, 20/.

## VIGNETTING CHAIR AND HEAD-REST COMBINED. 50s.



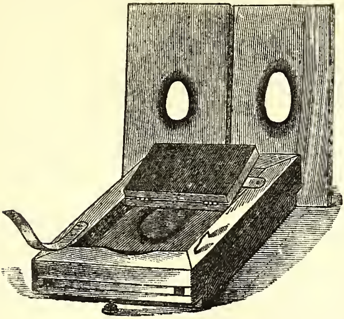

Easily adjusted to any figure.

## SCALES AND WEIGHTS.



3s. to 30s. per Set.

**MARION & CO., 22 & 23 Soho Square, London, W.**

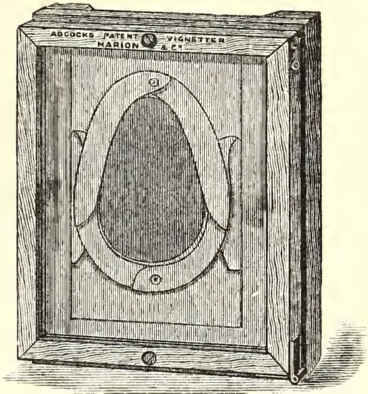


## NEW VIGNETTING FRAME.

These Frames have each three thick slabs of wood with bevelled oval openings, each a different size. These slabs are placed in front of the Printing Frames, and are held in their place by two screws, but their positions may be shifted; the oval holes being some distance from the negative, permit the rays of light to slant, thus effecting a soft pleasing vignette.

NONE CHEAPER! NONE BETTER!

$\frac{1}{4}$ plate, 2/6; $\frac{1}{2}$ plate, 4/; $\frac{1}{1}$ plate, 5/2.



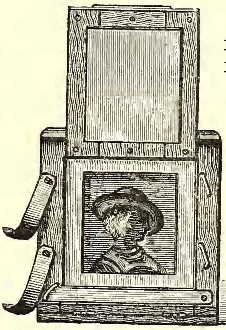

## ADCOCK'S PATENT VIGNETTER.

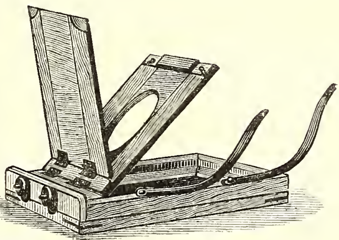
A very useful and ingenious Vignetter, to be screwed on front of Printing Frame.

For C.D.V., 3/; for Cabinet, 3/6; for $\frac{1}{1}$ plates, 6/.

## COWAN'S SPECIAL PRINTING FRAMES, FOR OPALS.

| | | |
|---|---|---|
| 8 × 6. | For Cabinets . . . | 4/ |
| 10 × 8. | ,, $\frac{1}{1}$ plate . . . | 5/6 |
| 12 × 10. | ,, 10 × 8 . . . | 7/6 |





MARION & Co

These Frames are specially prepared for printing Opal Pictures by contact, and allow the examination of the picture during the printing without the chance of the opal being shifted.

# MARION'S SCRAP ALBUMS.

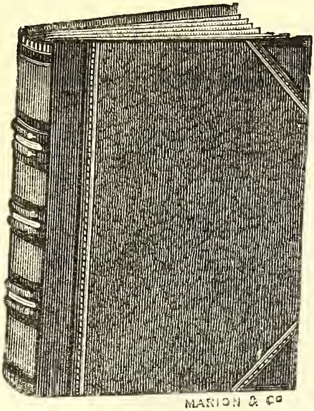
If a print from every negative that an Amateur may have taken be mounted into a book, it will be surprising how interesting the collection will grow. Such a collection would show the advance in quality of work, and would also be a memento of time and places. When these Scrap Albums are used in conjunction with one of our Note-Books, in which the particulars relative to the exposure of each plate are minutely recorded, a fund of information is gradually accumulated which will, at a glance, enable the Amateur to prejudge any exposures at any time afterwards with confidence, being guided thereto by the success or non-success of the print before him.

## THE "OSTRICH" SERIES.


These Scrap Books being bound in cloth, are at once neat and cheap. All books may be had in each size, bound either upright or oblong.

| With 36 Stout Paper Leaves. | | | With 24 Cardboard Leaves. | | |
|---|---|---|---|---|---|
| No. | Size. | Price. | No. | Size. | Price. |
| R.M. 124 | 10 × 7½ | 1/6 | R.M. 129 | 10 × 7½ | 2/4 |
| ,, 125 | 11 × 9 | 2/ | ,, 130 | 11 × 9 | 3/ |
| ,, 126 | 12½ × 10½ | 2/6 | ,, 131 | 12½ × 10½ | 3/8 |
| ,, 127 | 15 × 11 | 3/ | ,, 132 | 15 × 11 | 4/6 |
| ,, 128 | 17 × 12½ | 4/ | ,, 133 | 17 × 12 | 6/6 |

**MARION & CO., 22 & 23 Soho Square, London, W.**




MARION'S SCRAP ALBUMS—*Contd.*

# HALF-BOUND SERIES.

The Series R.M. 1 to R.M. 23 are of very good style and quality, open flat, and wear well. Are bound either upright or oblong.

| French Morocco, full gilt back, cloth sides, 60 stout cartridge leaves. | | | French Morocco, full gilt back, 30 stout cardboard leaves, linen jointed. | | | Morocco, hard grained, full gilt back and finish, 40 stout cardboard leaves, linen jointed, gilt edges. | | |
|---|---|---|---|---|---|---|---|---|
| No. | Size. | Price. | No. | Size. | Price. | No. | Size. | Price. |
| R.M. 1 | 10 × $7\frac{1}{2}$ | 3/ | R.M. 8 | 10 × $7\frac{1}{2}$ | 4/ | R.M. 16 | 10 × $7\frac{1}{2}$ | 8/ |
| ,, 2 | 11 × 9 | 3/6 | ,, 9 | 11 × 9 | 5/ | ,, 17 | 11 × 9 | 10/ |
| ,, 3 | 12 × $9\frac{1}{2}$ | 4/6 | ,, 10 | 12 × $9\frac{1}{2}$ | 6/ | ,, 18 | 12 × $9\frac{1}{2}$ | 12/ |
| ,, 4 | 15 × 11 | 6/6 | ,, 11 | $12\frac{1}{2}$ × $10\frac{1}{2}$ | 7/ | ,, 19 | $12\frac{1}{2}$ × $10\frac{1}{2}$ | 13/ |
| ,, 5 | 17 × $12\frac{1}{2}$ | 9/ | ,, 12 | 15 × 11 | 10/ | ,, 20 | 15 × 11 | 16/ |
| ,, 6 | $17\frac{3}{4}$ × $14\frac{3}{4}$ | 12/ | ,, 13 | 17 × $12\frac{1}{2}$ | 12/ | ,, 21 | 17 × $12\frac{1}{2}$ | 18/ |
| ,, 7 | 21 × 15 | 15/ | ,, 14 | $17\frac{3}{4}$ × $14\frac{3}{4}$ | 14/ | ,, 22 | $17\frac{3}{4}$ × $14\frac{3}{4}$ | 24/ |
| | | | ,, 15 | 21 × 15 | 17/6 | ,, 23 | 21 × 15 | 30/ |

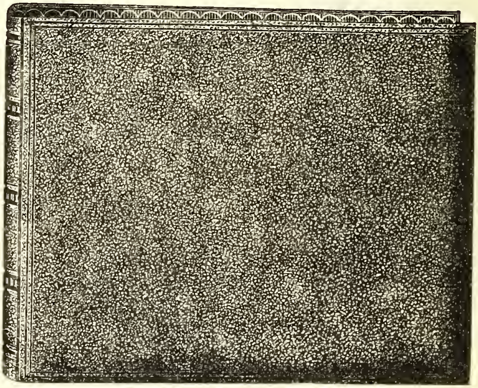
# FULL-BOUND SERIES.

**These Books are very Durable and the Best Obtainable.**

| Anglo-Russia, extra gold lines, gilt roll, 30 stout cardboard leaves, linen jointed, gilt edges. | | | Morocco, best Levant, blocked blind and gilt, 40 stout cardboard leaves, linen jointed, gilt edges. | | |
|---|---|---|---|---|---|
| No. | Size. | Price. | No. | Size. | Price. |
| R.M. 62 | 10 × $7\frac{1}{2}$ | 10/ | R.M. 70 | 10 × $7\frac{1}{2}$ | 16/ |
| ,, 63 | 11 × 9 | 12/6 | ,, 71 | 11 × 9 | 17/ |
| ,, 64 | 12 × 9 | 14/ | ,, 72 | 12 × $9\frac{1}{2}$ | 22/ |
| ,, 65 | $12\frac{1}{2}$ × $10\frac{1}{2}$ | 16/ | ,, 73 | $12\frac{1}{2}$ × $10\frac{1}{2}$ | 24/ |
| ,, 66 | 15 × 11 | 23/ | ,, 74 | 15 × 11 | 30/ |
| ,, 67 | 17 × $12\frac{1}{2}$ | 26/ | ,, 75 | 17 × $12\frac{1}{2}$ | 35/ |
| ,, 68 | $17\frac{3}{4}$ × $14\frac{3}{4}$ | 35/ | ,, 76 | $17\frac{3}{4}$ × $14\frac{3}{4}$ | 45/ |
| ,, 69 | 21 × 15 | 42/6 | ,, 77 | 21 × 15 | 50/ |

MARION'S SCRAP ALBUMS—*Continued.*

# NEW PADDED SERIES.




These Books are decidedly the most elegant, and better finished than any yet introduced. A special feature is the improved principle of jointing the leaves, which permits the books to be opened freely at any part. The leathers used in binding are all carefully selected, and the inlaid designs at the corners of the calf-bound series make these books very striking and effective. May be had either upright or oblong.

Bound Seconds Morocco, Padded, Blind Lines.

| No. | Size. | Price |
|---|---|---|
| R.M. 99/1 | 11 × 9 | 12/6 |
| ,, 99/2 | 12 × 9 | 17/6 |
| ,, 99/3 | 15 × 11 | 22/6 |

Bound Best Gros Grained Morocco, Padded, Gilt Line.

| No. | Size. | Price. |
|---|---|---|
| R.M. 921/1 | 11 × 9 | 18/6 |
| ,, 921/2 | 12 × 9½ | 25/ |
| ,, 921/3 | 15 × 11 | 30/ |

Bound Selected Calf, inlaid design at corners of covers, Padded.

| No. | Size. | Price. |
|---|---|---|
| R.M. 920/1 | 11 × 9 | 24/ |
| ,, 920/2 | 12 × 9½ | 31/6 |
| ,, 920/3 | 15 × 11 | 42/ |

Scrap Albums, with Double Paper leaves suitable for showing unmounted Photographs, with or without linen fore-edge, bound in cloth, lettered "Photographs." The photographs are inserted by the corners into slits made in the leaves, the advantage being that two or more may be kept together in the same slit. They are easily removable, so that others can be substituted when desired.

**MARION & CO., 22 & 23 Soho Square, London, W.**

MARION'S SCRAP ALBUMS—*Continued.*

| Sizes | No. of Leaves. | Plain Edges. | Bound Edges. |
|---|---|---|---|
| 11 × $8\frac{1}{2}$ | 30 | 7/ | 8/6 |
| ... | 50 | 9/ | 10/6 |
| $12\frac{1}{2}$ × $10\frac{1}{2}$ | 30 | 9/6 | 12/ |
| $12\frac{1}{2}$ × $10\frac{1}{2}$ | 50 | 12/6 | 15/ |
| 17 × $12\frac{1}{2}$ | 30 | 15/ | 20/ |
| ... | 50 | 20/ | 25/ |

*A good variety of latest Editions of Stamp Albums always in Stock, from* 7s. 6d. *to* 30s.

# PHOTOGRAPH ALBUMS.

MARION & Co., being one of the largest firms of Album Manufacturers, have always a large stock of such goods of every description, ranging from the cheapest to the most costly produced. They will always be glad to show samples.

**"Punch," December 24, 1881.**—"*In acknowledgment of his having produced the handsomest, most decorative, and most original Album for Photographs, we hereby decorate Mr. Marion (of Marion & Co.) with his own Patent Clasp, and create him Duke of St. Albums. The Public will send him the Orders.*"


## MARION'S

## MOUNTING SOLUTION for PHOTOGRAPHS.

1s. per bottle.

This Solution has been in use during the last five years in many large Photographic Establishments, and will be found to possess the following qualities :—

**It has no disagreeable smell;**
**It does not cockle the thinnest Mounts;**
**It does not discolour the Photograph;**
**It does not perish; and it is easily used.**

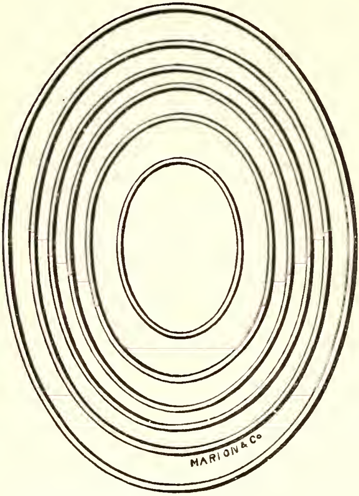
**DIRECTIONS FOR USE.**—Place the bottle in warm water, or on a stove, till the Solution is melted. Apply it with a stiff brush (which must be perfectly dry) to the back of the Photograph. Let the Photograph thus coated remain for a few seconds, and then place it on the Mount and press it well down.

*The above packed, and free per post,* 1s. 6d.

**Brushes for Mounting Solution, 8d. each.**

**MARION & CO., 22 & 23 Soho Square, London, W.**

# METAL RIMS FOR PHOTOGRAPHS.




Prices include Glass and Backs, with Rings.

Not less than one Dozen each size supplied.

| SIZE. | PER DOZ. |
|---|---|
| $4\frac{1}{4} \times 3$ | 2/ |
| $5 \times 3\frac{3}{4}$ | 2/4 |
| $6\frac{3}{8} \times 4\frac{1}{2}$ | 3/6 |
| $7\frac{5}{8} \times 5\frac{1}{4}$ | 5/3 |
| $8\frac{1}{2} \times 6\frac{1}{8}$ | 6/3 |
| $9\frac{5}{8} \times 7$ | 8/6 |
| $11 \times 9\frac{1}{2}$ | 10/9 |
| $12\frac{1}{2} \times 10\frac{1}{2}$ | 17/3 |


# GILT METAL FRAMES

## WITH CHAINS.

*For Transparencies.*

| SIZE. | EACH. |
|---|---|
| $\frac{1}{4}$ plate | 1/ |
| $\frac{1}{2}$ ,, | 1/6 |
| $\frac{1}{1}$ ,, | 2/ |
| $10 \times 8$ | 2/6 |
| $11\frac{1}{2} \times 7\frac{1}{2}$ | 2/6 |
| $12 \times 10$ | 3/ |

MARION & CO., 22 & 23 Soho Square, London, W.

## PERMANENT CARBON ENLARGEMENTS ON PAPER.

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|---|---|---|---|---|---|---|
| 1 | 12 × 10 (and smaller) | £0 11 3 | £0 1 6 | £0 12 0 | £0 2 0 | £0 0 6 |
| 2 | 15 × 12 | 0 15 0 | 0 2 3 | 0 15 9 | 0 3 0 | 0 0 9 |
| 3 | 16 × 13 | 0 15 0 | 0 2 3 | 0 15 9 | 0 3 0 | 0 0 9 |
| 4 | 18 × 15 | 0 18 0 | 0 3 0 | 1 0 6 | 0 4 0 | 0 1 3 |
| 5 | 20 × 16 | 1 1 0 | 0 4 6 | 1 3 3 | 0 4 6 | 0 1 3 |
| 6 | 24 × 18 | 1 2 6 | 0 4 9 | 1 4 9 | 0 6 9 | 0 1 9 |
| 7 | 24 × 20 | 1 7 9 | 0 6 9 | 1 11 6 | 0 8 3 | 0 2 0 |
| 8 | 26 × 21 | 1 13 0 | 0 9 0 | 1 16 0 | 0 10 6 | 0 2 6 |
| 9 | 28 × 22 | 2 0 0 | 0 12 0 | 2 5 0 | 0 13 6 | 0 3 9 |
| 10 | 30 × 24 | 2 5 0 | 0 13 6 | 2 9 6 | 0 15 0 | 0 3 9 |
| 11 | 36 × 28 | 2 7 6 | 0 19 6 | 2 17 0 | 1 1 0 | 0 5 3 |
| 12 | 48 × 36 | 4 10 0 | 1 10 0 | 4 14 6 | 1 10 0 | 0 15 0 |

An extra charge of 3s. is added to the above prices when enlargements have to be made from prints or positives.

## ENLARGEMENTS ON BROMIDE PAPER.

| No. | Size. | From Negatives. | From Prints or Positives. | Rough Mounting. |
|---|---|---|---|---|
| 1 | 10 × 8 | £0 3 6 | £0 6 3 | £0 0 6 |
| 2 | 15 × 12 | 0 4 3 | 0 7 0 | 0 1 0 |
| 3 | 18 × 15 | 0 5 0 | 0 8 0 | 0 1 3 |
| 4 | 20 × 16 | 0 6 0 | 0 9 0 | 0 1 3 |
| 5 | 22 × 18 | 0 6 9 | 0 9 9 | 0 1 6 |
| 6 | 24 × 20 | 0 6 9 | 0 9 9 | 0 2 0 |
| 7 | 26 × 21 | 0 11 0 | 0 14 3 | 0 2 3 |
| 8 | 30 × 24 | 0 11 0 | 0 14 3 | 0 3 9 |

MARION & CO., 22 & 23 Soho Square, London, W.

# PRINTING FRAMES.

**These Frames are so constructed that they can be easily opened, in order to watch the process of printing.**

| | | | | | FELT PADS for Regulating the Pressure of Frames. |
|---|---|---|---|---|---|
| 1157 | With Strong Glass, | $4\frac{1}{2} \times 5\frac{1}{2}$, | with two bars and springs | £0 4 0 | |
| 1160 | ,, ,, | $6 \times 8$ | ,, ,, | 0 5 6 | |
| 1162 | ,, ,, | $9\frac{1}{2} \times 12$ | ,, ,, | 0 8 0 | 1/ |
| 1164 | ,, ,, | $12 \times 14$ | ,, ,, | 0 11 6 | 1/6 |
| 1167 | ,, ,, | $14 \times 18$ | with three ,, | 1 1 0 | 3/ |
| 1172 | ,, ,, | $19 \times 26$ | ,, ,, | 2 0 0 | 4/ |
| 1170 | ,, ,, | $21\frac{1}{2} \times 30$ | with four ,, | 2 9 6 | 4/6 |
| 1171 | ,, ,, | $30 \times 43$ | with five ,, | 4 12 0 | 9/ |
| 1171 *bis* | ,, ,, | ,, | on stand and castors | 6 16 0 | .. |
| 1173 | ,, ,, | $39 \times 56$ | with six bars and springs | 8 6 0 | 11/6 |
| 1173 *bis* | ,, ,, | ,, | on stand and castors | 10 15 0 | .. |

# IRON SUPPORTS ON CASTORS (folding up).

To hold Printing Frame and Washing Dish, forming a table.

| | | |
|---|---|---|
| 1193 | Iron Support, on Castors, to hold Pressure Frame, 1171, and Washing Dish 883 | £1 11 0 |
| 1194 | ,, ,, ,, 1170, ,, ,, 882 | 1 6 6 |
| 1195 | , ,, with Pressure Frame 1171, and Washing Dish 883 complete | 7 0 0 |
| 1196 | Iron Support, on Castors, with Pressure Frame 1170, and Washing Dish 882 complete | 4 5 0 |

*N.B.—If a Drawing Board be laid on the top of the Pressure Frame it serves as a useful Office Table, and being on Castors, may be easily moved about.*

**For further particulars see page 106.**

# ROUND ZINC CASES.

*To keep the prepared Paper in, to preserve it from the light.*

26 in. . . . . 2/6 | 30 in. . 3/6 | 39 in. . . . . 5/

# ZINC WASHING DISHES.

| No. | | | |
|---|---|---|---|
| 872. | $8\frac{1}{2} \times 11$ | with two handles | 2/ |
| 873. | $10\frac{1}{2} \times 13\frac{1}{2}$ | ,, ,, | 2/6 |
| 874. | $12 \times 17\frac{3}{4}$ | ,, ,, | 3/ |
| 875. | $15 \times 22$ | ,, ,, | 4/ |
| 884. | $21 \times 28$ | ,, ,, and tap to empty | 8/6 |
| 882. | $23 \times 32$ | ,, ,, | 9/6 |
| 883. | $32 \times 44$ | ,, ,, | 17/6 |
| 885. | $44 \times 60$ | ,, ,, | 35/ |

**MARION & CO., 22 & 23 Soho Square, London, W.**

*Printed by* R. & R. Clark, *Edinburgh.*